Historic, archived document

Do not assume content reflects current scientific knowledge, policies, or practices.

SHOUT
SHARE
IT

UNITED STATES DEPARTMENT OF AGRICULTURE

BULLETIN No. 732

Contribution from the Bureau of Plant Industry
WM. A. TAYLOR, Chief

Washington, D. C. November 14, 1918

SMYRNA FIG CULTURE

By

G. P. RIXFORD, Physiologist, Crop Physiology and Breeding Investigations

CONTENTS

	Page
The Smyrna Fig Industry	1
Origin of Smyrna Fig Culture	2
Introduction of Smyrna Figs into the United States	3
Classification of Cultivated Figs	4
Crops of the Fig Tree	6
Ability of the Caprifig to Carry the Winter Crop	9
The Fig Flowers	10
Caprifig Seeds	15
Application of Caprifigs to Smyrna Trees	18
Caprifig Plantations	21
The Seedling Fig Orchard at Loomis, Cal.	21
Harvesting and Curing	22
Packing Figs	24
Shipping Fresh Figs	25
Smyrna Fig Culture in the Southern States	26
Starting a Smyrna Fig Orchard	28
Descriptions of Varieties	34
Opportunities in the Industry	40
Bibliography	41

WASHINGTON
GOVERNMENT PRINTING OFFICE
1918

THE PUBLICATION of a bulletin on the Smyrna fig has become necessary, because recent investigations have developed facts not previously noted and no literature is available which gives all the particulars necessary to a perfect understanding of the intricacies of the industry in this country.

It is thought important to encourage the more extensive cultivation of one of the most wholesome fruit foods known to agriculturists, a fruit the culture of which promises in the near future to become an important industry in this country, and also to correct errors into which authors have fallen for the lack of the opportunities for investigation presented in California, among which may be mentioned inaccuracies in relation to the classification of fig flowers and the reason for the paucity of seeds in caprifigs.

The writer desires to express his obligation for valuable suggestions to Dr. L. O. Howard, Chief of the Bureau of Entomology, United States Department of Agriculture, the author of a valuable article on Smyrna figs.

UNITED STATES DEPARTMENT OF AGRICULTURE

BULLETIN No. 732

Contribution from the Bureau of Plant Industry
WM. A. TAYLOR, Chief

Washington, D. C. ▼ November 14, 1918

SMYRNA FIG CULTURE.

By G. P. Rixford, *Physiologist, Crop Physiology and Breeding Investigations.*

CONTENTS.

	Page.
The Smyrna fig industry	1
Origin of Smyrna fig culture	2
Introduction of Smyrna figs into the United States	3
Classification of cultivated figs	4
Crops of the fig tree	6
Ability of the caprifig to carry the winter crop	9
The fig flowers	10
Fig pollination	11
Life of the Blastophaga	12
Proportion of male and female insects in caprifigs	14
Oviposition by Blastophaga	15
Caprifig seeds	15
Seeds accompanied by secretion of sugar	16
Caprification	16
Application of caprifigs to Smyrna trees	18
When Smyrna figs are receptive	18
Several applications of caprifigs advantageous	18
Caprification not an expensive operation	19
When to gather profichi caprifigs	19
Caprification of common figs	20
Caprifig plantations	21
The seedling fig orchard at Loomis, Cal	21
Harvesting and curing	22
Packing figs	24
Shipping fresh figs	25
Smyrna fig culture in the Southern States	26
Starting a Smyrna fig orchard	28
Making and rooting cuttings	30
Adaptation to climate	30
Preserving mamme caprifigs	31
Soil requirements	31
Cultivation and irrigation	32
Pruning	32
Grafting	32
Freedom from diseases and insect pests	33
The splitting of figs	34
Fig breeding	34
Descriptions of varieties	34
Smyrna varieties	35
Capri varieties	38
Opportunities in the industry	40
Bibliography	41

THE SMYRNA FIG INDUSTRY.

The United States is annually importing from Asia Minor and the countries of southern Europe from 19 to 20 million pounds of dried figs of a value of nearly a million dollars. About two-thirds of the tonnage and nine-tenths of the value consist of figs of the Smyrna type. The area in the Southwestern States and California is equally as well adapted to the fig industry as is the Meander Valley of Asia Minor and is more than extensive enough to produce many times the quantity imported into this country. At the present time the annual production of Smyrna figs in California, which is almost the total yield in this country, is not far from 2,000 tons. The imported figs can not be bought for less than 17 or 18 cents a pound wholesale,

whereas there is a good profit in growing such figs for one-half that price. When American-grown Smyrna figs can be put on the market at 15 cents a pound retail, the consumption will be greatly increased. The field will therefore be a promising one for many years to come.

The pollination of Smyrna fig flowers by the fig insect *Blastophaga psenes* is one of the most obscure and complicated processes known to botanists. Caprification was little understood and even considered unnecessary by most of the leading botanists and horticulturists of Europe almost up to the beginning of the present century. They believed it to be the result of ignorant superstition on the part of the inhabitants of Asia Minor. They did not believe that the fig and caprifig were the female and male forms of a single dicœcious species, but persisted in classifying them as two separate species. This belief was generally adhered to until the indispensable necessity of caprification was demonstrated in 1885 by Dr. Gustav Eisen, of Fresno, Cal. (8).[1] Therefore, it is not strange that the operation was little known and appreciated even by people familiar with the growth of common figs.

ORIGIN OF SMYRNA FIG CULTURE.

The fig family (Moraceæ) is one of the largest in the vegetable world. Botanists have identified and described more than 600 species, mostly tropical evergreens, frequently of gigantic size, often climbers or epiphytic. Very few of the species produce edible fruits, but many yield other useful products. One of them, *Ficus elastica*, is an important rubber producer.

All of the leading cultivated figs belong to the species *Ficus carica*. Two or three other species producing edible fruits may be mentioned here, but they are of little importance. Among them is the *Ficus sycomorus* of Egypt, the fruit of which is consumed by the natives of that country. Another, *Ficus roxburghii*, native to the lower slopes of the Himalaya Mountains in northern India, produces a fruit of very large size, in massive clusters, but of not very high quality. *Ficus pseudocarica* of northeastern Africa (the Italian colony of Eritrea and Abyssinia) produces a small, dark-colored, sweet, quite palatable fruit, the capri form of which is receiving considerable attention in California.

The original home of the cultivated fig (*Ficus carica*) conforms closely to that of the olive. Alphonse de Candolle (2) sums up the subject in a few words, as follows: "The result of our inquiry shows, then, that the prehistoric area of the fig covered the middle and southern parts of the Mediterranean Basin, from Syria to the Canaries." The fig has been cultivated in these regions from the earliest

[1] The serial numbers in parentheses refer to the "Bibliography," pp. 41–43.

historical times. The extreme ease with which it can be propagated from cuttings, its resistance to heat and drought, its early bearing, its value as human food, and the ease of its culture had in the early ages much to do with its wide dissemination.

INTRODUCTION OF SMYRNA FIGS INTO THE UNITED STATES.

Regarding the first introduction of the Smyrna fig into the United States, it may be mentioned that a detailed account by the writer of this bulletin was reprinted by Dr. Gustav Eisen (11, pp. 67–69) in 1901. For present purposes a synopsis will be sufficient.

Believing that the soil and climate of California were perfectly adapted to the growth of Smyrna figs, the writer, who was at that time business manager of the Evening Bulletin of San Francisco, Cal., induced the proprietors of that journal to make an appropriation of funds to undertake the introduction from Asia Minor of the genuine Smyrna fig of commerce. In January, 1880, the assistance of E. J. Smithers, then United States consul at Smyrna, was enlisted in aid of the enterprise. A remittance was made to cover the expense of forwarding a small shipment of 500 cuttings, including a few caprifig cuttings. This shipment reached San Francisco on June 8, 1880, but owing to defective packing, a considerable portion of the wood had rotted and the season was so far advanced that the cuttings made but a feeble growth, although the greatest care was taken with them. However, 200 of them were saved and showed promise of becoming thrifty trees.

About this time Mr. Smithers arrived in San Francisco en route to Chinkiang, China, to which consulship he had just been assigned. He stated that at the time the shipment was made he and the dragoman of the consulate at Smyrna had caused to be planted 4,000 cuttings, which had meantime become rooted trees and could be purchased at from 8 to 10 cents each, the usual price of trees in Asia Minor. Rather than disappoint the county subscribers of the paper who were expecting the promised trees that season, it was then determined to import the whole lot. Funds were therefore forwarded to an American merchant in Smyrna with instructions to purchase the trees referred to and ship them at once. About the first of April, 1881, instead of the trees, a letter dated February 16 came to hand, from which the following paragraph is taken:

> I have had Mr. ——— at my office, who says that the 4,000 cuttings he had planted and to which your order refers (on E. J. Smithers' suggestion) have by this time grown up into strong young trees from 4 to 6 feet high, and he is offered $1 per tree at the nursery at Aidin. He says he can not afford now to part with them at anything under $1.25 each, from this port (first cost).

The prices mentioned in the letter discouraged further negotiations for this lot. However, correspondence was kept up with the agent during the summer, and in September, 1881, orders were sent to make

a large shipment of cuttings which it was found could be had at a reasonable price from one of the best orchards in the Meander Valley, the most important fig district of Asia Minor. Every precaution had been taken to assure the safe arrival of this consignment, even by shipping moss from New York in which to pack the cuttings. The cases on arrival in New York were repacked before being shipped across the continent by the southern route, as the season was mid-winter.

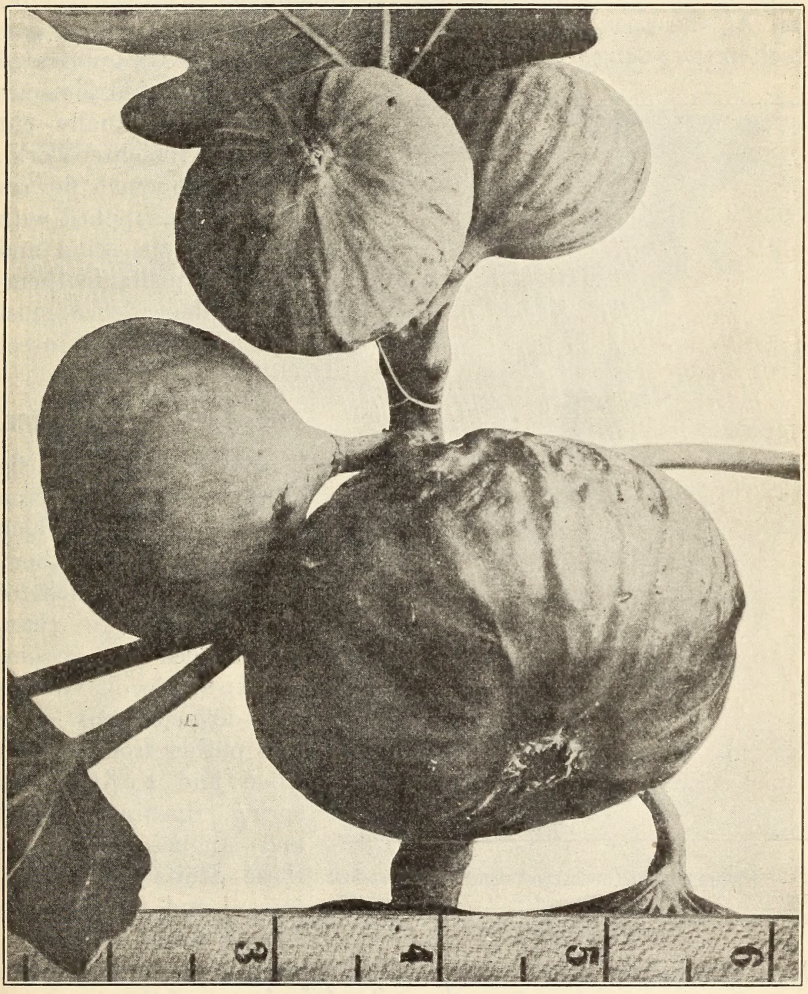
The shipment consisted of 14,000 cuttings, including several varieties of the best Smyrna figs. It weighed several tons and arrived in excellent condition. W. B. West, of Stockton, James Shinn, of Niles, Gov. Leland Stanford, of San Francisco, and Dr. J. D. B. Stillman, of Lagona, Cal., had shares in the importation, but the San Francisco Bulletin Company had the larger portion and paid the greater part of the expense. A large number of cuttings were distributed to 3,000 county subscribers of the Bulletin, while the individual shares went to the different partners in the enterprise. Gov. Stanford planted most of his cuttings on his ranch near Vina, Cal., now the property of Stanford University. The trees resulting from this importation are now growing in all parts of California and other Southwestern States. Some have attained gigantic size, a number recently measured by the writer having trunks 3 feet in diameter.

CLASSIFICATION OF CULTIVATED FIGS.

The cultivated varieties of *Ficus carica* include more than 100, most of which have been successfully established in the Southern and Southwestern States and California. The Lob Ingir variety, the Turkish name of the common Smyrna fig (fig. 1), is unique in requiring pollination in order to bring its fruit to perfection. Linnæus and other botanists as early as 1744 reached the conclusion that the capri fig is the male form and all the common varieties, including the Smyrna, the female forms of a dicœcious species. The caprifigs are male, because they contain male or staminate flowers; the common varieties and Smyrnas are female, because they contain only female or pistillate flowers. These fertile or female figs may be again divided into two classes, namely, the Smyrna figs, the flowers of which must be pollinated in order to mature fruit, and the other large class, frequently called the Adriatic class, the fruits of which reach maturity without pollination. The latter race includes most of the varieties cultivated in all fig-growing countries. Some of the best and most extensively grown in this country are the Adriatic, Brunswick, Barnissotte Black, Barnissotte White, Dottato or Kodato, White Genoa, Gentile, Large Black Douro (one of the largest in cultivation), Mission or California Black, Pastellière (Eisen says if he could plant only one blue variety it would certainly be this fig), Black

San Pedro, and Versailles. In the Gulf and Atlantic Coast States the kinds most generally grown are the Celeste, Magnolia, Lemon, Brunswick, Ischia, and Brown Turkey.

The common cultivated figs are of two kinds, the caprified or Smyrna figs and the common cultivated figs which do not require



P36915CP

FIG. 1.—Lob Ingir (Smyrna) figs. The large fig is fully mature, the others partly so. (Nearly natural size.)

caprification. Until recent years only varieties of the latter kind were known in America. The figs of the Smyrna type do not set any fruit at all unless the flowers are pollinated, that is, unless the fig trees are caprified. Ordinary fig trees of the noncaprifying varieties produce fruit perfectly well by themselves wherever the climate

permits. The culture of Smyrna figs on the contrary necessitates the simultaneous culture of caprifigs which harbor the fig insect and bear the pollen necessary to fertilize figs of the Smyrna type.

The fig is not a fruit in the sense in which we regard the apple, peach, etc., but is what is known to botanists as a receptacle, upon the inner surface of which are arranged hundreds of unisexual flowers. At the apex of the receptacle is an opening called the eye, which in the young fruit is closed by a number of scales or imbricated bracts. The blossoms are therefore effectually cut off from the outer world, and as the female flowers can not be supplied with pollen by the wind and can not pollinate themselves, dependence must be had on the fig insect (*Blastophaga psenes*).

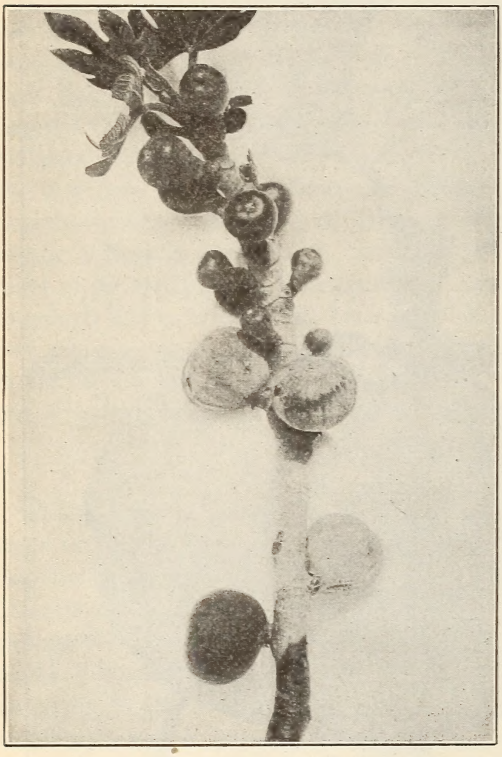


FIG. 2.—Mature mamme (winter) and young profichi (spring) caprifigs. The mamme figs are the larger ones. (Nearly one-half natural size.)

CROPS OF THE FIG TREE.

All of the female fig trees, both of the Smyrna class, the fruit of which never matures without pollination, and most of the other large class, which does not require pollination, have two well-defined crops. The first pushes from the old wood and appears in spring, ripening in July and August. In Spain these fruits are called *brebas* and in France *figues fleurs* or *figues d'été*. The next, which is the main crop, called in Spain *higos* and in France *figues d'automne*, springs from the axils of the leaves of the new wood and ripens in summer and fall.

The male or caprifig tree has two well-defined crops and a third which is in doubt by some authorities (figs. 2 and 3). To these for convenience the Neapolitan names *profichi* (spring crop), *mammoni* (summer crop), and *mamme* (winter crop) have been applied. The mamme crop forms in autumn on the wood of the current season and the Blastophaga from the preceding mammoni oviposits in

them when they have reached the size of filberts. By December these mamme fruits are the size of small walnuts and change but little during the winter. The insect hibernates in them in the larval condition and will endure a temperature of 14° or 15° F. without injury. As the weather becomes warm in spring, the insects develop rapidly and are ready to issue in April (fig. 4), when the spring (profichi) crop on the same or other capri trees is in a receptive condition. This crop grows in clusters on the old wood at the extreme ends of the branches and, unlike the mamme, which is nearly spherical, is much

FIG. 3.—Mammoni (fall) caprifigs. (About one-half natural size.)

larger and usually has a pronounced neck. It is produced in enormous numbers, many times greater than any other crop, a wise provision of nature, as it is the one which is most abundantly supplied with pollen and also the one which is exclusively used to pollinate the main Smyrna fig crop. The late summer crop of the capri tree, known as mammoni, unlike the others, pushes from the axils of the leaves on the new wood and matures from August to the middle of November. This crop serves to carry the Blastophaga through the late summer and fall months. The Blastophaga from these mammoni

figs oviposit in the winter crop and thus the cycle of the yearly life of the insect is completed.

Doubts have been expressed as to the existence of three distinct crops of caprifigs, and with good reason, for at times and in some climates belated mammoni hibernate with the mamme. H. G. Solms-Laubach says that in Europe there is no sharp distinction between

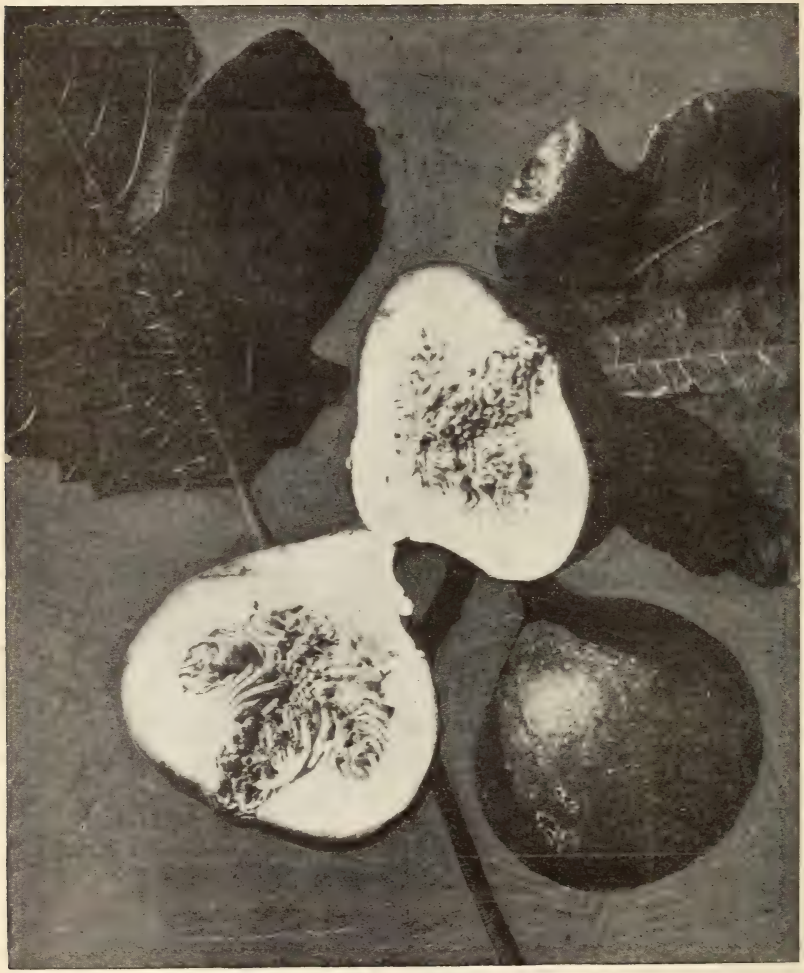


FIG. 4.—Mature profichi caprifigs with Blastophaga about ready to issue. (About two-thirds natural size.)

the mammoni and the mamme crops and that fruits of the former crop which do not mature in the fall remain as mamme over winter. They both occupy the same position on the branch, both developing on the new wood. The chief difference between the two is that the former contains a well-defined cluster of staminate flowers, while in the mamme with rare exceptions no male flowers have been observed

except in *Ficus pseudocarica*, which regularly bears pollen in the winter-generation caprifigs. These hibernating mammoni figs are so similar in form and general appearance to the mamme figs that without cutting them open it is difficult to tell them apart.

To summarize, the necessity of sheltering the fig insect the whole year round leads to the curious result that the caprifig trees bear through the winter on their bare branches the so-called winter generation or mamme caprifigs, from which issue in spring the fig insects, which thereupon lay their eggs in the enormously abundant spring generation of caprifigs or profichi. These profichi, which mature in June, are used to caprify the Smyrna figs, which at this season have myriads of young fruits just ready for the Blastophaga to enter. The caprifig trees also bear a somewhat scanty crop of summer-generation fruit called mammoni, which furnishes a breeding place for the fig insect and carries it over from season to season.

After late summer the fruits on the caprifig tree become irregular, and all sizes of fruits can be found on the tree at the same time; and generally the fig insects can be found issuing at any time from September to November. As winter comes on and the growth of the caprifig tree becomes slower, a few tardy fruits set, which hang on through the winter, constituting the winter generation or mamme crop noted already.

ABILITY OF THE CAPRIFIG TO CARRY THE WINTER CROP.

Probably more caprifig varieties are now established in California than are to be found in any other country in the world, owing in part to the enterprise of the late W. B. West, of Stockton; Mr. Van Lennep, of Auburn; George C. Roeding and G. N. Milco, of Fresno; Felix Gillett, of Nevada City; and largely to the United States Department of Agriculture. Here may be found most of the best varieties from the Smyrna district of Asia Minor, many from Greece, Italy, and the islands of the Mediterranean, and especially from the States of northern Africa, besides a host of seedlings of American origin.

Probably every Smyrna fig grower has observed the difference that exists in the ability of different varieties of caprifigs to carry through the winter crop. Many kinds never produce a winter crop, though they generally yield the spring or profichi crop in great abundance. Still others produce so few winter figs that they are of little use in perpetuating the Blastophaga. Some fail to bear a mammoni (summer) crop, or the figs push at a time that leaves a hiatus in the successive generations of the insects. Such trees can not produce a mamme crop unless they have the assistance of better trees, for it is well known that the mamme figs dry up and fall unless oviposited in by insects of the mammoni generation. It is a curious

fact that the egg of the Blastophaga is just as essential to make the caprifig hold on and mature as is the pollen to do the same for the Smyrna fig. This fact was observed in California by E. A. Schwarz, of the Bureau of Entomology, United States Department of Agriculture, as mentioned in the proceedings of the meeting of the Entomological Society of Washington, D. C., December 6, 1900 (45, p. 503).

Careful investigations extending over a period of several years indicate that the ability of a tree to support successfully the mamme crop through the winter is more a question of variety than of climate. Several instances are known where in the frosty portions of the San

FIG. 5.—The Samuel Gates Milco caprifig tree, 10 miles west of Modesto, Cal., which has carried the Blastophaga since 1868, unaided by any other tree.

Joaquin Valley, Cal., single isolated trees near Modesto and Lathrop, unassisted by others in the neighborhood, have carried the different crops uninterruptedly for more than 40 years (fig. 5). The possession of such trees by the grower is of supreme importance.

THE FIG FLOWERS.

Count H. G. Solms-Laubach and Dr. Paul Mayer, the German botanists; Olivier, the Frenchman; Gasparrini, Gallesio, and Pontedera, the Italians; and later Dr. Gustav Eisen are all agreed that there are four kinds of flowers in the fig. It may seem presumptuous to take exception to these authorities, but it is nevertheless a fact, easily demonstrable with the abundant material now accessible in

California, that there are really but two kinds of fig flowers, namely, pistillate and staminate, although it may be advisable to separate the pistillate flowers into two kinds—those of the caprifig, called gall flowers, and the ordinary flowers of all the female figs. These authors enumerate the four kinds as the male and female of the caprifig, the regular female flower of the Smyrna, and lastly the female flowers of the Adriatic class, which some of them contend have imperfect stigmas and can not be pollinated, and therefore call them mule flowers. Careful investigations by the writer have failed to disclose such flowers. Pontedera and Gallesio call them fico mula and fico semimula, a few of the latter being susceptible of pollination and the former not at all. This idea has become so fixed in the minds of some horticulturists that they are calling this class of figs "mule figs," a positive misnomer and entirely unwarranted by the facts.

The staminate flowers of the caprifig are arranged in a zone or cluster at the upper part of the fig, just within the eye. The remainder of the receptacle is filled with gall flowers which are perfect female flowers, the pistils of which are modified for the purposes of the female Blastophaga. The styles of these flowers are short and thick compared to those of the Smyrna and other female figs and are provided with a duct, down which the fig insect pushes her ovipositor into the ovary, where she deposits the egg. As evidence that these are female flowers, careful examination discloses the fact that these styles are surmounted usually by forked stigmas, the surfaces of which are provided with the usual cells or glands and the viscous coating to which the pollen grains adhere. With sufficient magnifying power the pollen tubes can be seen pushing their way from the surface of the stigma down through the cellular tissue into the ovary. The gall flowers of all caprifigs are alike except for slight variations in the shape of the stigmas.

As further evidence that all the gall flowers in the caprifig are perfect female flowers, some of the persistent stigmas from ovaries containing fertile seeds in a mammoni fig and others from galls containing fully developed Blastophaga in the same fig were placed side by side under the microscope and were found to be identical in cellular structure and in every other respect. The writer is therefore satisfied that the stigmas of the flowers of the mammoni caprifigs are equally as susceptible to pollination as are those of the female figs, and in fact are so pollinated, but fail to produce more than a few seeds, for the reason given in this bulletin under the heading "Caprifig seeds." (See p. 15.)

FIG POLLINATION.

When the Blastophaga enters the spring crop of the caprifig, the stamens are in an undeveloped condition and the anthers will not be ready to discharge their pollen until about two months later—

that is, at the time when the next generation of insects is ready to issue. It is, therefore, impossible for a fig to pollinate itself. Here, then, is a striking instance of one of nature's methods of preventing self-fecundation.

In the regular female flower of the Smyrna fig the style is long and slim, two or three times longer than the style of the flower of the caprifig, and this is the reason that it is unsuited for the purpose of the insect. It is divided at the summit usually into two stigmas,

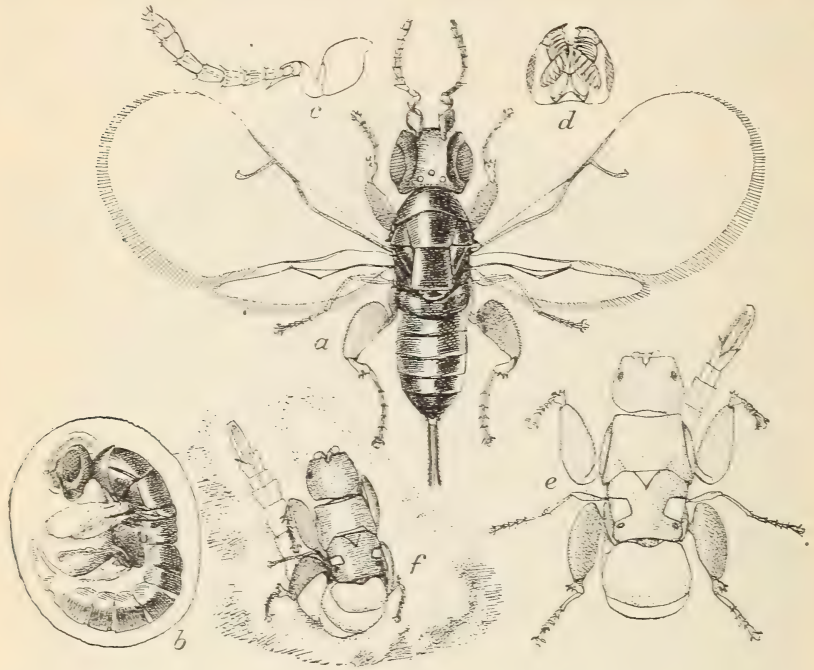


FIG. 6.—*Blastophaga psenes: a*, Adult female with wings extended, seen from above; *b*, female not yet entirely issued from pupal skin and still contained in gall; *c*, antenna of female; *d*, head of female from below; *e* and *f*, adult males. (All greatly enlarged.)

and they appear to be identical with those of the flowers of the Adriatic class, to which belong all those figs which reach an edible condition without pollination. The stigmas of the latter, some authors say, are mostly malformed and can not be fertilized.

LIFE OF THE BLASTOPHAGA.

The beneficent insect upon which depends absolutely the whole Smyrna fig industry is a small species of very strange structure (figs. 6 and 7). The female, a little less than an eighth of an inch in length, is black in color, is provided with wings, and in a favorable wind has been known to fly several miles. The male is wingless, is amber or brownish yellow in color, and somewhat resembles a small

grub. After many unsuccessful attempts, the insect was sent over to the United States from northern Africa in 1899 by Walter T. Swingle, of the United States Department of Agriculture. Success was due to avoiding methods which had previously often failed by confining the efforts to the winter generation and by the ingenious device of wrapping each caprifig in tin foil to prevent evaporation. It was discovered later, however, that the Blastophaga was already here, having been accidentally introduced with fig trees from southern Europe about 1865, but this did not become known to orchardists until 1908, having been, so far as known, confined to an isolated tree 10 miles west of Modesto and one or two others in the vicinity of Lathrop, Cal. (50, 54).

In California the insect, which hibernates in the larval form during the previous few months, reaches maturity in April. The male leaves the gall first. He moves about the interior of the fig, and, finding a gall containing a female, gnaws a hole through the cortex of the ovary at the base of the style and fertilizes the female while she is still in the gall. The gravid female enlarges the opening and sometimes makes another, usually at the base of the style, probably because it is the point of least resistance. In from 22 to 48 hours she leaves the gall, reaching the open air through the cluster of male flowers, the anthers of which at this time have burst and are shedding large quantities of pollen. Her body is moist and sticky and she is frequently so loaded with pollen that she is unable to fly until she divests herself of much of it in the same way that the common house fly strokes its body with its legs.

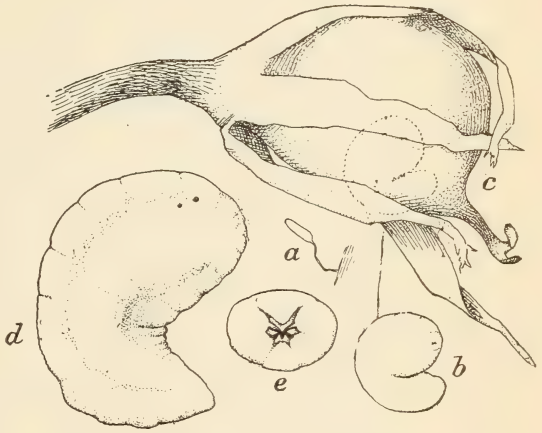


FIG. 7.—*Blastophaga psenes: a*, Egg; *b*, young larva; *c*, outline of young larva in gall; *d*, full-grown larva; *e*, mouth of full-grown larva. (All enlarged.)

After being relieved of part of the load, she flies to the nearest fig, and if it be in the right condition she immediately seeks the opening at the apex. At this time the figs are hard and from a quarter to three-quarters of an inch in diameter and the eye is closed by the overlapping scales. Some authors assert that with her powerful mandibles she is obliged to cut away a portion of one of these scales to effect an entrance; but this is unnecessary, as she is able to push her head under the thin edges and after a struggle of sometimes five

minutes or more pushes down the zigzag way to the interior of the fig, generally leaving her wings behind.

While one insect is probably sufficient to fertilize a fig, it is not unusual where they are very abundant, as at the Maslin orchard at Loomis, to find a dozen or fifteen in one small fig and as many more in a struggling mass trying to effect an entrance; often the cluster of wings can be seen radiating from the eye like the plumes of a miniature feather duster. If the caprifig from which the insect has issued has been hung in a Smyrna tree, she enters a Smyrna fig and then finds she has made a mistake, as the flowers are of such shape that she can not oviposit in them, and after wandering about in a vain effort to dispose of her eggs, in this way doing her useful work of fertilizing the female flowers, in most cases she crawls out. When the weather is warm, say 90° to 100° F., the insects are very active and come out of the caprifig with a rush. The writer has seen 40 issue in one minute. The issue takes place almost entirely in the forenoon, unless a cold windy morning is succeeded by a hot sun in the early afternoon, when a considerable number appear. The movement depends much upon the weather. During cool windy mornings very few issue, but if the next morning is warm, calm, and sunny a great rush occurs. The insects continue to issue from a single fig for a week or ten days if the weather is favorable, and from the figs of various capri trees for two to three weeks. After the females have left the fig most of the males soon follow, and, being wingless, drop to the ground like the females which have lost their wings in entering the Smyrna figs.

Every Smyrna fig not entered by the Blastophaga dries up and falls from the trees. In a few days the caprified fig undergoes a remarkable change. It begins to increase rapidly in size, becomes smooth by a lessened prominence of the ribs, and loses its pea-green color, assuming a decidedly pruinose tinge, this being true also of the caprifig.

PROPORTION OF MALE AND FEMALE INSECTS IN CAPRIFIGS.

The writer has taken some pains to determine the proportions of the sexes of the Blastophaga in caprifigs, and has found from actual count of the insects of several varieties that the proportion runs from two-thirds to three-quarters females. The number of galls in good sound caprifigs, according to size, runs from 500 to 1,600. A medium-sized mamme caprifig has been found to contain 1,015 healthy galls; good Milco profichi caprifigs have been found to contain 1,200 to 1,600. After the female insects leave the caprifig most of them live only 24 hours, though a very few will be found alive at the end of 48 hours. It is doubtful whether they eat at all. After the female has fulfilled the object of her existence, namely, providing for the future generations of her species, she dies.

OVIPOSITION BY BLASTOPHAGA.

If the Blastophaga has entered a caprifig, a crop of which should at the time be in receptive condition, she finds no difficulty in depositing her eggs. Authors differ as to the technique of the operation. The German botanist Count H. G. Solms-Laubach says she pushes her ovipositor down through the duct in the style and thus places the egg in the ovary. Dr. Cunningham, the English botanist, in his memoir on the fertilization of *Ficus roxburghii* (5), says, "The deposition must apparently take place, not in the style, but by means of penetration of the upper surface of the ovary." Another author says, "Should the fig entered prove to be a caprifig, she lays as many eggs at the base of as many male flowers as she can find and then dies."

Careful investigations by the writer confirm the view of Solms-Laubach. This view must be correct; otherwise the insect would be able to oviposit in the Smyrna and other edible figs (which she never does), and thus give us a collection of insects instead of seeds.

After the insect reaches the interior of the caprifig she moves about over the mass of stigmas; curving the posterior portion of the abdomen under and forward, she thrusts the ovipositor repeatedly down between the flowers, seeming to be guided entirely by the sense of feeling rather than sight. Finally, after eight or ten attempts, she succeeds in pushing it down through the central duct of the style and rests for a minute or two while the egg is being ejected.

When the insect is wandering over the flowers the ovipositor does not appear longer than the sheath. This apparently misled Dr. Cunningham, who states that the ovipositor is too short to reach the ovary through the style. When an entrance to the style is effected, the ovipositor is extended, telescopelike, to three times the usual length, which enables the insect to deposit her egg well down in the ovary. The style is white and translucent, and as the egg-laying instrument is yellow or amber colored it is plainly visible with a microscope of moderate power when pushed down into the ovary. Within two or three hours after oviposition in a flower the stigma and style turn brown, rendering it easy by opening a fig to determine that the work has been well done.

CAPRIFIG SEEDS.

The mammoni crop of the capri tree is the only one which has been observed to produce seeds, and then only in small numbers. The obvious reason for the presence of seeds is that this crop is pollinated by the Blastophaga of the preceding profichi crop. The profichi crop itself yields no seed, because the mamme figs preceding it have no viable pollen, although the pistils are provided with receptive stigmas.

Gasparrini (17) found 20 seeds in 40 mammoni figs and reached the conclusion that not more than one flower in 2,000 is a perfect female flower, all the others being gall flowers, incapable of fertilization. The writer has found as many as 75 fertile seeds in one fig, and from a large number of mammoni seeds plants have grown at the United States Plant Introduction Garden, Chico, Cal. From careful observations he has been forced to the conclusion that all gall flowers are perfect female flowers and susceptible of pollination and that most of them are pollinated, but if the Blastophaga deposits an egg in the ovary the resulting larva prevents the development of the ovule and no seed is formed. The seeds therefore found in the mammoni figs are from those flowers in which the insect failed to oviposit.

SEEDS ACCOMPANIED BY SECRETION OF SUGAR.

There seems to be some connection, not yet well understood, between the seed and the secretion of sugar and coloring matter. The pedicels and floral envelopes of the seeds in mammoni figs are succulent, sweet, and generally of a pink color, while all parts of the gall flowers containing Blastophaga are white and quite dry, the difference in appearance being so marked that the seeds can readily be picked out with a pair of forceps from the mass of galls by their succulence and pinkish color.

CAPRIFICATION.

The term caprification is derived from the word *capri*, the name by which the male or pollen-bearing fig is known, and is applied to the process of hanging the caprifigs in the Smyrna trees. The details of the process are somewhat obscure and complicated, and it is not strange that it is little understood by the public in general, though known to the inhabitants of Asia Minor more than two thousand years ago. Theophrastus, who wrote about 350 years before Christ, describes the process as practiced at that time exactly as it is used at the present day in this country.

Undoubtedly the cultivated fig was originally a dicœcious species having about equal numbers of male and female trees. Through centuries of culture, varieties of the female figs have been developed which will produce fruit without caprification, but such figs never produce fertile seeds. Figs of the Smyrna type absolutely require fertilization to set fruit at all, and such fruits produce an abundance of fertile seeds, which undoubtedly add to the flavor and quality of the dried Smyrna figs. In orchard practice it is not necessary to have, as in the state of nature, approximately one half of the trees male and the other half female. One or two caprifig trees per acre of fig orchard is sufficient to supply an abundance of caprifigs to fertilize the whole orchard.

It is well known that the flowers of the fig are inside the receptacle which becomes the fruit. Caprifig trees look exactly like ordinary fig trees and bear fruits which look like figs, the only difference being that instead of producing seeds the caprifigs are fitted with small galls just about the size of seeds, in which the fig insect develops. The caprifig differs from the Smyrna and other female figs in having a cluster of male or staminate flowers just within the eye. As the Smyrna, unlike common fig varieties, can not reach maturity unless the flowers are supplied with pollen and the fig can not pollinate itself, dependence must be had on some outside agency. This agency is the fig insect (*Blastophaga psenes*). The spring (profichi) crop of the capri or male tree is used for this purpose. In California and other Southwestern States the insects begin to issue in the warm valley from the 10th to the 20th of June and continue often until well into July.

In leaving the fig the female insect passes through the zone of male flowers, thereby dusting herself all over with the fertilizing pollen, which she then carries to the young fruits of the Smyrna fig. The fig insect can live only a few hours outside of the caprifig. In fact, only a portion of the male insects as a rule leave the caprifig at all, and the females leave only to deposit eggs for the next generation. In other words, the fig insect is restricted absolutely to the caprifig and can breed nowhere else. This means that the caprifig tree must furnish a succession of generations of fig fruits in which the fig insect can multiply; that is, as one crop of caprifigs ripens the next crop must be ready to receive the insect. This proper adjustment of crops does occur in some few caprifig varieties, but in many others the adjustment is not so close, as explained elsewhere.

It only remains to state that the fig insect is unable to breed in the Smyrna fig itself. The fig insect merely carries pollen from the caprifig fruit and is not able to lay her eggs in the minute flowers which line the Smyrna fig fruit, because the styles of these flowers are too long to permit the egg to be placed properly.

Briefly, then, caprification consists in suspending in the Smyrna fig tree in June a few chaplets or baskets of caprifig fruits of the spring generation or profichi fruits of the caprifig tree which contain myriads of minute fig insects (*Blastophaga psenes*). The minute winged female insect in issuing from these caprifig fruits becomes dusted with pollen, which she carries into the young and receptive fruits of the Smyrna fig. Once inside the Smyrna fig fruit, the female insect wanders around trying to find a suitable flower for oviposition. All she accomplishes is to dust thoroughly the stigmas of the fig flowers with pollen, thereby insuring the setting and ripening of the fruit, but she does not succeed in ovipositing in the Smyrna fruit.

No other horticultural industry is so intimately tied up with a specific insect as is Smyrna fig culture, which is, indeed, absolutely impossible without the beneficent help of this minute creature.

APPLICATION OF CAPRIFIGS TO SMYRNA TREES.

Various methods are employed in suspending caprifigs in the Smyrna trees. The figs may be strung on strings or raffia by means of a coarse needle into which the string is threaded. These chaplets of four or five figs each are then suspended in the Smyrna branches, preferably in the shady parts of the tree. Another method is to put the caprifigs into cornucopia-shaped baskets made of coarse galvanized-wire cloth. These baskets may be used year after year, or may even be left suspended in the trees.

Some experienced growers find that it pays to suspend small pans filled with moist sand in the trees, into which the caprifigs are pushed, stem down, two-thirds of their length. This prevents the fig from drying out and permits all the Blastophaga to escape.

WHEN SMYRNA FIGS ARE RECEPTIVE.

Smyrna figs are in a receptive condition from the time they are the size of filberts to that of small walnuts, say from five-eighths of an inch to about an inch in diameter. At this time the fig is glossy, with prominent ribs. Soon after caprification it becomes smooth and loses its gloss. (See fig. 8.) On cutting open such a fig a few hours after it has been entered by the insect the styles and stigmas of the flowers will be observed to have turned brown from injury caused by the Blastophaga. The best evidence, however, to indicate that the fig has been entered by the insect is the presence at the eye of the wings which have been left behind in effecting the entrance. These will be visible for a day or more if the weather is not windy.

SEVERAL APPLICATIONS OF CAPRIFIGS ADVANTAGEOUS.

Dr. Eisen has shown that a number of applications of caprifigs to each tree greatly increases the crop, for the reason that when the caprifigs are first hung in a Smyrna tree only a part of the figs are in a receptive condition. In warm weather these caprifigs are exhausted of most of the insects in four or five days. Meantime, other Smyrna figs have pushed and have reached a receptive condition, and another supply of caprifigs at this time will be required for their pollination. Three or four such applications four or five days apart will be found to increase greatly the setting of fruit. As the Smyrna crop depends absolutely upon the supply of insects it is found that a liberal application of caprifigs is desirable. For trees 4 to 6 years of age, 10 or 12 figs for each will be found sufficient, while for trees from 8 to 12 years old the number should be doubled. One experienced grower in the San Joaquin Valley, whose trees are about 12 years of age, informs the writer that he greatly increases his crop by applying as many as 50 to 150 caprifigs to each tree.

CAPRIFICATION NOT AN EXPENSIVE OPERATION.

Occasionally fig growers raise objection to the cultivation of Smyrna figs on account of the trouble of caprification, but as there is no other way of raising them the grower must submit to the slight handicap if he wishes to produce dried figs of high quality. It has been found from experience that one man can caprify about 40 acres. His time will be consumed for a period of about three weeks. Mr. George C. Roeding, of Fresno, Cal., says that the cost of the work in his large orchard does not exceed 2 cents per tree, or from $1 to $1.50 per acre.

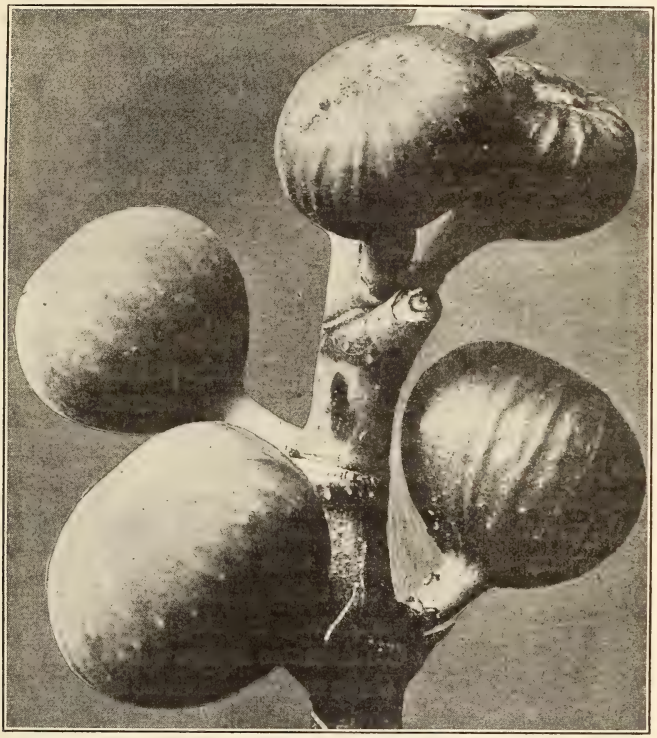


FIG. 8.—Change in appearance of figs due to caprification. Two caprified figs are shown on the left, three uncaprified ones on the right.

WHEN TO GATHER PROFICHI CAPRIFIGS.

The proper condition for gathering profichi caprifigs is easily ascertained by opening a few figs and looking for the appearance of the male, as previously mentioned, but is readily indicated by a slight softening of the fig.

Experience has developed some methods of handling profichi figs that are worth mentioning. The spring generation of Blastophaga commences to issue from about the tenth of June to the first week in July, the time depending upon the locality and the weather, warm

weather hastening development and cool weather retarding it. At this time the weather is very warm in the great valley of California. If large quantities of figs are to be gathered, a considerable saving is effected with no harm to the insect by letting them fall to the ground when detached from the branches, but the figs must not be allowed to remain on the hot ground in the sun longer than a few minutes. With a temperature of 90° F. many insects will be killed in half an hour, and most of them in an hour. In an hour and a half every one of them will have succumbed. The figs in the shade of the tree or those attached to the branches are not affected except at very much higher temperatures. It is therefore necessary to pick up the figs from the ground about as fast as they are thrown down by the men in the trees.

CAPRIFICATION OF COMMON FIGS.

To show how erroneous is the conclusion of some authors that the pistillate flowers of the Adriatic class of figs are malformed and can not be pollinated, it may be mentioned that the writer by applying the Blastophaga to the so-called "mule" figs of more than 50 varieties found that in every instance heavy fertile seeds were produced and in as large proportion as in the Smyrna fig. From these seeds, thousands of plants have been grown at the United States Plant Introduction Garden, Chico, Cal. From such cross-pollinated seeds some interesting and valuable varieties are being secured. The breeder does not have long to wait for results, since most of the seedlings bear fruit at the age of 2 and 3 years.

A striking instance of the fertilization of common figs occurred at Loomis, Cal., where Mr. Andrew Ryder, a prominent fruit grower, had grafted a portion of an Adriatic tree with Smyrna scions. The Smyrna set quantities of fruit, and wishing to secure a crop the owner hung in the tree caprifigs containing Blastophaga ready to issue. Some of the insects entered the Adriatic figs on the ungrafted part of the tree. The writer secured three mature Adriatic figs which showed by their abnormally large size that they had been entered by the insects. These three figs contained by actual count 4,800 heavy fertile seeds, or an average of 1,600 for each fig—certainly a good crop for a "mule" fig which, according to some writers, will not breed.

Experience is showing that the time may come when it will be worth while to caprify all of the common figs, that is, those varieties which otherwise reach an edible condition without pollination. A caprified fig is a more nearly perfect fruit than an uncaprified one. The fruit is considerably increased in size, and the seeds contain plump kernels which give a delicious nutty flavor, not apparent in uncaprified figs. Dr. Eisen was the first investigator to make the suggestion.

CAPRIFIG PLANTATIONS.

As the caprifig crop occasionally suffers from frost in the flat regions of the great valley, it is suggested that the fig growers of a locality combine and plant a caprifig orchard of a few acres in some frost-free foothill region. In this way the cooperators would insure themselves a steady supply of caprifigs at little cost.

All Smyrna fig growers appreciate the fact that there would be considerable advantage if caprifigs containing the insect could be had for a period of a month or six weeks, thereby insuring the pollinizing of more figs and an increase in the crops. With our present varieties of caprifig trees the caprifying season covers a period of only about three weeks. The only way by which this period can be extended with capri varieties now cultivated seems to be by planting the capri trees in cool localities where the proximity of the sea or other influences retard the ripening of the figs and the development of the Blastophaga. In such localities as Loomis, Fresno, Indio, and Mecca, Cal., and Phoenix, Ariz., the insects from the profichi crop begin to issue from about the 10th to the 20th of June, while in localities within the influence of the ocean breezes, such as the cooler portions of Sacramento and San Joaquin Counties, the period of issue is a week or ten days later, and at Niles, Alameda County, Cal., on the eastern shore of San Francisco Bay, the time of issue is as late as July 25 or the beginning of August. A cooperative caprifig orchard could be so located as to supply the Smyrna fig growers with pollinizing material for the latest figs that could ripen before the advent of the fall rains.[1]

THE SEEDLING FIG ORCHARD AT LOOMIS, CAL.

Back in 1886, while a spirited discussion regarding the necessities of caprification was going on in California, E. W. Maslin, then of Loomis, Cal., sent to H. K. Thurber, a leading importing merchant of New York City, for a box of the finest imported Smyrna figs. The seeds of these figs were planted by the gardener at the State Capitol, Sacramento. The resulting seedlings were planted by Mr. Maslin on his ranch at Loomis in 1887. These trees grew thriftily and in the course of three or four years began to set fruit, nearly all of which failed to mature for lack of pollination, the fertilizing insect, Blastophaga, not then having been introduced into that part of the State.

The Blastophaga were first colonized on George C. Roeding's trees at Fresno, and in the following year, 1901, they were established in the Maslin orchard, at Loomis, where the trees matured fruit for the first time. The fruiting of the trees demonstrated that about half of them were caprifigs and the other half of the female or edible type. This result was naturally to be expected, as the Smyrna fig is the female form of a dicœcious species.

[1] This would be a desirable undertaking for an association of fig growers, such as was formed at the Fig Institute at Fresno, Cal., January 4 and 5, 1918.

From this time a careful study of the trees and product was made, with the result that a number of new varieties of decided promise were found. Two of a new Smyrna class were discovered in 1908 by A. H. Brydges. These attracted attention from the fact that the fruit withstood uninjured two soaking rains which spoiled that on adjoining trees. The preservation of the fruit under these trying circumstances was due to the fact that the eye of the majority of the fruits is stopped by a drop of hardened, pellucid juice which effectually excludes rain, filth, beetles, and flies which might carry into the fig the germs of fermentation. This prevents souring, and it also prevents the entrance of insects which deposit eggs resulting in wormy figs. (See "Descriptions of varieties," pp. 36–37, Rixford variety.)

The Maslin fig orchard has played an important part in the development of the fig industry in California. At the fruit-growers' convention, at Stockton, in December, 1910, reports were current that a number of fig growers in the San Joaquin Valley were digging up their bearing Smyrna trees, owing to the difficulty of obtaining caprifigs containing Blastophaga to pollinate their fruit. Walter T. Swingle and the writer proceeded to Ceres, where most of the destruction of trees had occurred, and called a meeting of growers who could be quickly reached by telephone. There were 12 or 13 growers present, who were admonished not to destroy any more trees, as the United States Department of Agriculture had taken a lease on the Maslin orchard, containing 72 capri trees, and would furnish the entire crop to the growers at the bare cost of gathering and shipping the fruit, namely, 50 cents per box containing 160 to 175 figs. The growers next season availed themselves of the opportunity to the extent of over 600 boxes, 96,000 figs, with the result that no more fig trees were destroyed. In addition to devoting the entire crop of caprifigs of the orchard to the growers, cuttings from the best trees were offered gratis to anyone who desired to avail himself of the privilege. Besides several fine Smyrna varieties, the orchard contains several of the finest capri varieties in cultivation. Of the capri varieties, several bear the largest caprifigs ever seen in this country, with correspondingly large numbers of Blastophaga from the ample gall zones and having large staminate clusters with abundance of pollen. They possess, besides, a vigor and hardiness that has never failed to carry the mamme crop safely through the hardest frosts of California winters. Detailed descriptions of these will be found in another part of this bulletin.

HARVESTING AND CURING.

The fig ripens and dries on the tree and when it falls all of the small and medium-sized fruits are sufficiently cured to keep, while those of large size require further exposure to the sun for a day or two,

either on the ground or on wooden platforms. In some respects the normal climate of the great interior valley of California is superior to that of Asia Minor, where summer dews are prevalent and fall rains sometimes injure the crop.

It is a good practice to gather the figs very often, say two or three times a week. One successful grower who puts up an exceedingly fine product gathers the figs every day. One reason for this is that the eye of a caprified fig is usually quite open and the longer it remains on the ground the more likely it is to be visited by beetles that leave eggs inside the fig, causing a wormy product.

Sulphuring is not necessary to improve the appearance of Smyrna figs, as it is for the Adriatics and some other varieties. Some

P30025A—CP.

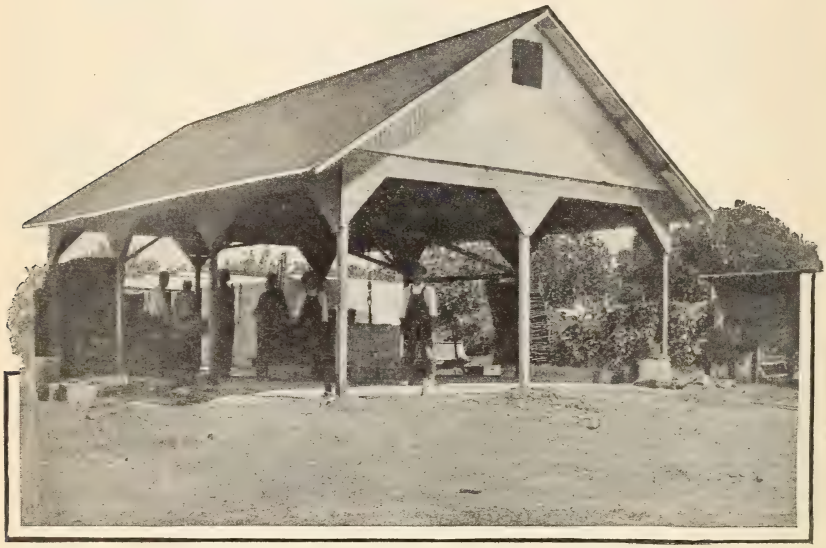
FIG. 9.—Drying grounds at Fresno, Cal. In the foreground figs are being dried on platforms, while to the left are stacks of trays already dried.

growers think that spreading the figs out on trays and stacking them so as to keep them out of the direct rays of the sun to finish up the drying makes them lighter colored.

The first operation after the figs are gathered from the ground is to rinse them in clear water and spread them out on wooden platforms, such as are used for drying raisins, until the surplus moisture has evaporated (fig. 9). They are then dumped into boxes. In the raisin region sweat boxes are used for the purpose. They should be pressed down into a solid mass and should remain in that condition until ready to be packed or sold to the packer. The product is thereby greatly improved, as the overdried fig absorbs moisture from the underdried, thus equalizing the whole mass. This process also causes the skin of the fig to absorb moisture and sugar from the interior pulp and this renders it pliable and tender.

PACKING FIGS.

Most growers pack the figs in clean cotton bags, in which condition they are sold to the packers, but others find they can add several cents per pound to the value of the product by doing their own packing. Many figs are packed in 5-pound and 10-pound boxes and many more in fancy cartons holding from one-half to 1 pound each. The expense of fitting up a packing house is inconsiderable, the appliances required being a kettle set in a furnace for heating boiling water or brine, forms for packing the figs in half-pound or 1-pound bricks, and a press to apply pressure to the packed product. The bricks which go into the cartons are wrapped in waxed paper, which tends to retard drying out.



P80025B—CP.

FIG. 10.—Processing house. The dipping vat is shown in the center.

The packing operations begin by exposing the figs to boiling brine for a minute or two in wire baskets or by means of a prune dipper where it is done on a very large scale (fig. 10). The brine is made with from 3 to 4 ounces of salt to the gallon of water. Care should be taken not to make the brine so salt as to be apparent to the taste in eating the fig. The object of the process is to destroy by heat the eggs of any insect that may have entered the fig while it was lying on the ground and also to help retain the moisture and prevent drying out, as it is well known that salt absorbs moisture to some extent. Some growers put their figs through a sizing machine at a certain stage of the work, separating the fruit into about three grades. The smaller and also any defective fruit, including split figs, finds a ready market ordinarily at 2 to 4 cents a pound, and is used by manufacturers of pastry products.

The medium and large fruits are packed by themselves, making two to three grades with names to suit the fancy of the packers. Those intended for ornamental cartons are flattened out between the fingers of the operator, the eye end is turned under and then the fig is split from apex to stem and spread out to the width of the form in which the brick is packed, being arranged in layers until the form is filled. The bricks are put under the press and thus compacted into a solid block. These blocks or bricks are wrapped in wax paper and placed in fancy cartons upon which the producer's name or brand is embossed or are packed in layers in 5-pound and 10-pound wooden boxes.

Another style of packing, called "lacoum" in Smyrna, in which each fig is pressed by hand into a square shape and then packed into rows in the cartons, is described and illustrated in Dr. Eisen's bulletin (11).

SHIPPING FRESH FIGS.

The consumption of fresh or undried figs in the city markets is building up a trade of considerable importance. The large populations, especially of peoples from southern Europe, who count the fruit in this condition as an almost indispensable luxury, have all brought to this country their liking for fresh figs, which demands that fruit growers cater to this trade. The Smyrna fig is so superior to the common varieties that when the supply is sufficient at reasonable prices, the markets can take large quantities of the fruit in this form.

Only the choicest fully mature specimens of uniform size should be shipped. Such fruit appeals to everybody. The usual method of packing now in use is in wooden boxes about 12 by 16 inches in size and corresponding in depth to the size of the largest figs, holding about 8 pounds. The fruit carries best when packed in a single layer, the boxes being lined with white paper and the rows of figs separated by strips of the same. No doubt egg boxes, in which each fruit would be out of contact with its neighbor, would be ideal carriers.

If a plan not too expensive could be devised by which ripe figs could be laid down in eastern cities, a large trade in Smyrna figs could be built up. Experiments have been made which have met with some success. A shipment of 50 boxes sent from Ceres, Cal., in an iced fruit car was sold readily in Chicago at 20 cents a pound. A smaller lot, shipped in a pony refrigerator from Indio, Cal., reached New York City in perfect condition and brought $4.62 per 1-layer box of 7 or 8 pounds. In each case the consignee asked for more. The best results were had with the pony refrigerators, but the cost of express charges on the pony and the necessary weight of ice are almost prohibitory. Fresh Smyrna figs are so much superior to any ever seen in eastern cities that they would meet with an active demand at reasonable or even high prices. Here, then, is a field

that ought to engage the attention of experimenters, not only in the Southwest, but also in the South Atlantic and Gulf Coast States.

SMYRNA FIG CULTURE IN THE SOUTHERN STATES.

Many varieties of Adriatic figs are already successfully cultivated throughout the great coastal plain from Texas to the Carolinas, chiefly for home consumption, canning, and preserving. The home fruit garden usually contains a few thrifty trees, which provide for the owner liberal supplies of fresh figs from the middle of July to well into September. The varieties now in most general cultivation are Celeste, Magnolia, Ischia, Brunswick, and Brown Turkey. The first mentioned is the favorite in Louisiana, especially in the neighborhood of New Orleans.

The Smyrna fig on the Pacific coast is equally as frost resistant as any of the varieties mentioned. In fact, some of the oldest and largest fig trees seen by the writer in the Southern States are of the Smyrna type. These trees, it is surmised, are accidental seedlings from imported Smyrna figs and include the capri, or staminate, as well as the Smyrna, or pistillate, trees, located at various widely separated points. Through the lack of fig insects to pollinate their fruits no crop is ever secured from such scattered Smyrna trees, the figs dropping when about half grown. On this account, Prof. Reimer (39), of the North Carolina Agricultural Experiment Station, advised that all such seedlings in North Carolina be cut down and replaced by varieties that do not require caprification. A caprifig tree was discovered and identified in the business section of San Antonio, Tex., through the assistance of E. B. Pauly. Other old Smyrna fig trees were located with the assistance of George E. Murrell, the horticulturist of a railway company. Prof. Boudousquie, of Spring Hill College, Mobile, Ala., has half a dozen capri trees, 6 years old, at Battles Wharf, on the east shore of Mobile Bay. Capt. Lawrence, at Fairhope, in the same neighborhood, has grown Smyrna figs with varying success for several years by using caprifigs containing fertilizing insects, these caprifigs being sent to him from California, but has not succeeded in establishing a colony of Blastophaga on his capri tree, perhaps because it is not of a good variety.

On Dauphin Island several old fig trees 8 to 10 inches in diameter had suffered severely from a hurricane at the time the writer examined them, but showed no injury from frost. To the warm waters of the Gulf of Mexico is due the immunity of the locality from frost.

At Brunswick, Ga., a large capri tree was found at the home of Mrs. L. M. Russell. The tree is supposed to be 18 years old. It is 5 feet in circumference 6 feet from the ground and has a spread of 35 to 40 feet. At Savannah a large Smyrna fig tree was discovered on the premises of Mrs. S. D. Richards. This tree has a trunk 10 inches in diameter. Capt. S. G. Stoney, president of the Charleston County Agricultural Society, C. F. Nevins, and M. L. Bissell rendered

valuable assistance in locating these trees. At Augusta, Ga., R. C. Berckmans is growing many varieties of figs and was able to give the writer much valuable information on the subject. From these investigations it is apparent that there exists no climatic obstacle to the growing of Smyrna figs in the Southern States.

Besides ascertaining the climatic fitness for the successful growth of Smyrna trees, a further important step looking to successful Smyrna fig culture has been taken. Colonies of the fig insect have been established at two points in the South. A colony was established in the old capri tree at San Antonio, Tex., in 1917, and in two trees at Brunswick, Ga. The insects sent in caprifigs from the Department of Agriculture's orchard at Loomis, Cal., were placed in the San Antonio tree by E. B. Pauly, where they established themselves and seemed to thrive in spite of a fall in temperature to 25° F.; but later a drop to 13° F. exterminated the whole colony. The capri trees at Brunswick, Ga., belonging to Mrs. L. M. Russell and George H. Cook carried their crop through the winter of 1917–18 without injury, and the fig insects entered the spring crop of caprifigs, causing a full setting of fruit. Mrs. Russell sent a few of her figs to San Antonio and reestablished the colony on the old tree at that point.[1]

A serious obstacle to the fig industry in the South is the prevalence of wet weather during the ripening period, causing most varieties to sour and also preventing the fruit from drying on the trees, as it does everywhere in California.

Sufficient evidence has been accumulated as to the possibility of Smyrna fig culture in the Southern States to justify experimenting with this type of fig. Even if the crop can not be dried without artificial heat, it is probable that owing to its greater sugar content the Smyrna fig will resist the tendency to sour and for this reason will prove to be suitable for shipping in a fresh state to the northern and other city markets.

It should be borne in mind, however, that success in growing Smyrna figs is absolutely dependent upon the presence of caprifig trees colonized with the fig insect. Until it has been demonstrated that the insect can be carried successfully through several seasons it will not be advisable to undertake commercial plantings of figs of the Smyrna type. There are, however, many scattered chance seedlings of the Smyrna type already in existence the fruit of which now goes to waste. Experiments should be conducted in caprifying their crops if female trees or in establishing the fig insect in them if they happen to be caprifigs. The summer or main crop of edible figs of the Smyrna type should be setting in late May or early June, when they are ready for caprification; the profichi or main crop of the caprifig tree should be setting in March, when the fig insects may best be introduced.

[1] Caprifigs from the Russell tree at Brunswick placed in the Richards tree at Savannah (Smyrna type) on June 1, 1918, caused a large crop of excellent figs to mature, the first fruits ever secured from this old tree.

STARTING A SMYRNA FIG ORCHARD.

In starting a fig orchard the selection of the best varieties adapted to the locality is a matter of supreme importance. It can not be too strongly impressed upon the beginner that his main dependence in planting the orchard should be upon the Lob Ingir, the standard Smyrna fig of the world and the variety universally grown commercially in the Meander Valley of Asia Minor. (See fig. 1.) Sometimes planters are advised to put out the Adriatic, under the mistaken idea that it is a heavier bearer than the former. Experience has demonstrated that if the Smyrna is liberally supplied with caprifigs the

FIG. 11.—A fig tree of the Stanford variety. The fruit does not split in ripening, as in the case of other figs, and it ripens about two weeks earlier than that of the Lob Ingir.

reverse is the case. The eastern cities are flooded with the inferior Adriatic figs, the repulsive acid taste of which, derived from the sulphur used in bleaching, is giving California dried figs a bad reputation. Shippers should realize that they are doing irreparable injury to the fig trade by putting this inferior fruit upon the market. It must be apparent to anyone who has sampled the Adriatic fruit now found in quantities in the eastern cities that a great fig trade which will successfully compete with the imported Smyrna fruit can not be built up with this inferior Adriatic fruit.

If the planter desires to experiment in a small way, some of the varieties described in another part of this bulletin may be tried.

Perhaps among these the Stanford variety (fig. 11), on account of its earliness and nonsplitting character when ripening, is one of the most promising.

Almost any grower of Lob Ingir figs in California can supply cuttings at a nominal rate when pruning his trees. This enables a fig orchard to be started at a very small cost; though, if preferred, trees can now be obtained from most nurserymen.

One of the indispensable requirements of successful Smyrna fig growing is a carefully selected assortment of capri trees. Since the undertaking is absolutely dependent on the Blastophaga, it is evident that varieties must be selected that experience has shown are capable

FIG. 12.—The original Milco caprifig tree, Niles, Cal.

of sustaining all three caprifig crops and all three generations of the fertilizing insects.

The first consideration is to secure capri varieties which never fail to carry a good winter (mamme) crop in spite of frosts and adverse conditions. This insures insects for an abundant spring (profichi) crop and must be followed by a good summer (mammoni) crop. As an abundant supply of good caprifigs at the proper season is the ultimate object of the capri plantation, four or five of the best kinds should be planted at the rate of two good trees to each acre of Smyrnas. In this list the grower can not be too earnestly urged to include the Milco caprifig, which has proved itself to be one of the best to carry all the crops of the caprifig to perfection (fig. 12).

Sometimes it is thought advisable to plant capri varieties first, for the reason that they usually fail to carry the mamme crop through the winter until they have reached the age of 4 or 5 years. As the capri trees produce the other two crops as early as the Smyrna, the difficulty may be avoided by securing from older orchards mamme caprifigs early in April to caprify the spring crop of the capri trees, thus providing a supply of profichi for caprifying the Smyrna crop of the young trees.

MAKING AND ROOTING CUTTINGS.

A fig orchard may be started by planting cuttings directly where the future trees are to stand, as is done in Asia Minor, but the almost universal practice in California is to plant the cuttings in nursery rows where they can be supplied with the necessary moisture until rooted. Cuttings taken from terminal branches and about 10 to 12 inches in length are preferable. In taking the cutting it should be cut through a node rather than between nodes, for the reason that between the nodes the pith is quite large and when planted leaves a hole in the bottom of the tree, while at the node the stem is solid.

In putting out the cuttings in the dry climate of California and other Southwestern States it is important that they be planted deeply, leaving not more than half an inch above the surface. If any large proportion of the cutting projects above the ground, the evaporation from the bark is such that the absorption below, there being no roots, will be insufficient to supply the loss of moisture and many of the cuttings will die.

The trees should be planted not less than 30 feet apart, and at the time of planting should be cut down to within about 2 feet of the surface. The ground should be plowed deeply and well pulverized, and if any hardpan exists it should be loosened by exploding a half stick of dynamite where each tree is to stand. The trees should be liberally irrigated until they are well established, but irrigation should not be continued later than the beginning of August. Anything that tends to keep up the circulation of the sap, preventing the wood from thoroughly ripening, renders the young trees liable to injury by frost.

Smyrna fig trees will give a few figs the third year. The fourth year, if they do well, should furnish a crop that will pay all the expenses of cultivation. From that time on, the crop and profits will increase for a generation.

ADAPTATION TO CLIMATE.

The fig endures about the same degree of cold as the olive. If not long continued, a minimum of 12° to 14° F. above zero is not injurious to mature trees, but this appears to be about the limit. Young trees if in a succulent condition would be badly set back if not killed at such temperatures. The cultivated fig (*Ficus carica*) delights in a dry, warm climate, but thrives also in a moist one, but not in the

moist Tropics. The Smyrna fig, by far the best type in cultivation, is more exacting than the Adriatic class in the relation between climate and fruit production, as its crop of fruit is absolutely dependent on the fertilizing insect (*Blastophaga psenes*) and its culture on a commercial scale is therefore confined at present to regions where the winters are sufficiently mild to permit the mamme or winter insect-bearing crop to live through without injury.

While figs for fresh consumption can be grown successfully in moist and cool coastal regions, fig drying can be successfully carried on only in regions where the weather from the end of August and continuing through September and October is sufficiently warm to ripen the crop. This season of the year should be free from rains. A great commercial industry will always be confined to the production of dried figs; therefore, at this season of the year dry, sunny weather is indispensable.

PRESERVING MAMME CAPRIFIGS.

The discovery was made a few years ago by Henry Markarian, of Fresno, Cal., that mamme caprifigs gathered in December before the advent of severe frosts and packed in layers in damp sand or damp sphagnum moss and placed in outhouses or cellars where they may be protected from excessive cold can in this way be carried through the season of cold weather. It appears that the figs contain sufficient latex and the ovaries sufficient protoplasmic matter to feed and develop the insect to maturity, and all that is required is moisture enough in the packing material to prevent drying out. It is found that the insects reach maturity about the same time as those left on the tree.

Repeated experiments by the writer have shown that the period of issue can be regulated to a considerable extent by adjusting the temperature of the room or building where the figs are kept. A slight increase in the temperature hastens the development, and a corresponding lowering of the temperature retards it. In one instance figs were gathered on December 19, and the insects began to issue early in April. Some of these figs were sent from San Francisco to a location in southern Texas. The receiver reported the arrival of the figs in good condition and the insects began to issue on April 13 and entered the figs of his profichi crop. From these experiments it is evident that detached caprifigs can be successfully carried through winters in storage where the temperature is so low that the figs on the trees might be destroyed, thus making it possible to grow Smyrna figs in regions where frosts would otherwise interfere with success.

SOIL REQUIREMENTS.

The soil requirements of the fig are less exacting than those of climate. The size and quality of the fruit, however, are affected to a considerable extent by the character of the land on which it is grown.

Some varieties, like the Mission, seem to thrive on almost any kind of soil from light sand to heavy adobe. It is pretty well settled, however, that the best Smyrna figs are grown on quite heavy soil rather than light sand. The water requirements of the fig are less than those of most other fruit trees. Still, it demands above all well-drained land and some irrigation. It does not succeed, for instance, on land where the Bartlett pear thrives. Next to a well-drained, compact loam, a rich sandy loam is best, and a good dressing of stable manure will always repay the cost of application in the increased size of the fruit. A good percentage of lime in the soil is important. Some growers contend that lime reduces nematode infestation to a considerable degree.

CULTIVATION AND IRRIGATION.

The fig tree responds to good care and culture as readily as any other fruit tree. The orchard should be cultivated after every irrigation, and toward the end of the season it is well to have the ground under the trees mellow in order to avoid a hard surface upon which the ripe figs fall. Many orchards in California, especially on deep bottom land, produce good crops entirely without irrigation, while on shallower soil a good supply of water is necessary. A prominent grower at Fresno says that he raises large crops by a heavy irrigation in May or the beginning of June and another when caprifying at the end of June.

PRUNING.

The fig requires less pruning than any other fruit tree. After setting and cutting back to about 2 feet from the ground the aim should be to produce an open, symmetrical top, so as to admit plenty of sunshine and at the same time shade the trunk to prevent sunburn; still the branches are to be kept up out of the way of the cultivators. Many planters use tree protectors to shade the trunk until the tree top offers the necessary shade. In the beginning the top should be started with three or four branches, which are to be the framework of the future tree. The after treatment will require little more than the removal of chafing branches and the suckers which start from the ground at the base of the trunk. The main idea to be kept in mind is that the ripening crop requires plenty of air and sunshine.

GRAFTING.

Occasionally it will be found convenient or advisable to change inferior varieties to Smyrnas by grafting. Any of the ordinary methods employed on other fruit trees can be used. The only point of importance is always to use for scions 2-year-old wood. It may be from one-fourth to three-fourths of an inch in diameter. If 1-year-old wood is used, not more than one-fourth to one-third of the grafts

will grow, while if 2-year-old wood is used and the work carefully done 95 per cent of them will grow. This is the experience of A. H. Brydges, a skillful horticulturist and caretaker of the demonstration fig orchard of the Department of Agriculture at Loomis, Cal.

Experienced fig growers are now thoroughly convinced of the superiority of Smyrna figs over any other kind as a profitable crop, and in many places they are grafting over their Adriatic trees to Smyrnas, thus about doubling the value of the product. If the tree to be changed is large, it is best to take two years for the work, as to remove the whole top in one season often proves too much of a shock to the parent tree. If the grafts do well, they will produce some figs the second year.

FREEDOM FROM DISEASES AND INSECT PESTS.

The fig possesses several advantages over other deciduous fruit trees. One is that little thinning is required to produce large-sized fruit, as is necessary with peaches, apricots, etc., since the size of the crop can be regulated by the number of caprifigs applied. The crop is never cut off by late spring frosts, for the reason that it pushes long after the last frosts occur. Up to the present time the fig tree in California has also been virtually free from insect pests and diseases, so that spraying has never been necessary.

A few cases of fungus on Adriatic and Mission trees have been reported, but they are not regarded as serious. A blackish smut or fungus sometimes is found in dried figs. Its appearance is not unlike the smut in cereals, and it can usually be detected by a discoloration of the skin. It may also be detected when no outward discoloration occurs by squeezing the figs, which ruptures the inclosing membrane and forces out the spores in a dark dustlike powder. As the spores are blown about by the wind, it is important that all affected figs be immediately destroyed by burning or depositing them in a receptacle containing a weak solution of formalin or corrosive sublimate, or even hot water. All refuse figs and trash from the orchard should be cleaned up and burned.

Large fig-eating beetles, known as June bugs, are troublesome in parts of Arizona, but have not been observed in California. Nematodes, minute worms infesting the roots, are found in many localities, but as yet they have not become a serious pest.

A small spotted beetle (*Carpophilus hemiplerus*) works in souring and fermenting figs, prunes, etc., and is really a packing-house insect. The little fly which frequents souring figs is the well-known vinegar fly. These insects can be abated to a considerable extent by cleaning up and burning the refuse leaves and decaying fruit from the orchard.

THE SPLITTING OF FIGS.

In certain seasons a few of the ripening figs split upon the tree. While this is an injury to some extent, it is not a very serious one. There seems to be a difference of opinion as to the cause. Some growers are firmly of the opinion that it is caused by too many Blastophagas, or, in other words, by overpollination; others think that it is due to too much irrigation. The writer, however, is convinced that these are not the principal causes, but that the cause is principally climatic. If damp weather, not necessarily rain, occurs during the ripening period, it seems to stimulate the circulation of the sap and gorges the fruit with juice until the pressure is such that the tender skin fails to resist and the fig splits open. If, however, this period of dampness is followed by warm, sunny weather, such figs dry without souring, the split closes up, and they are readily disposed of at 2 to 4 cents per pound, which pays for gathering and caring for them. The proportion of figs that split rarely exceeds 25 per cent; nearly always the proportion is much less.

Trees have been observed standing on the banks of irrigating ditches where the supply of moisture was continuous and showing less split figs than trees in the same orchard that received only occasional irrigation. It appears that when the ground has become too dry and water is then applied a stimulation in the circulation of the sap is caused and is almost invariably followed by more or less splitting, while if the supply of moisture has been continuous few, if any, splits occur. The splitting of oranges and prunes is attributed by many to the same cause.

FIG BREEDING.

Fertile seeds can be secured from all kinds of our cultivated figs by caprification and the breeder can readily perpetuate by vegetative propagation desirable hereditary characteristics in his seedling trees. It has been found from experience, however, that about one-half of such seedlings are capri or staminate trees. The process is exceedingly simple. A twig is selected with a number of figs from three-eighths to three-quarters of an inch in diameter (the receptive size in most varieties) which have not been entered by the insects. Drop into a paper bag a caprifig with Blastophaga ready to issue and tie it tightly over the twig, and the insects will do the rest. At the end of two or three weeks remove the paper bag and replace it with one of mosquito netting for protection against birds and to prevent the ripe dried fig from falling to the ground.

DESCRIPTIONS OF VARIETIES.

For the purposes of this bulletin it is deemed sufficient to describe those Smyrna fig varieties that are promising or have already assumed importance in the fig industry. Of the hundred or more

caprifig varieties, either imported or originated from seed in this country, it is deemed sufficient to describe only those which from their desirable qualities are of permanent interest to Smyrna fig growers. Dr. Eisen (11) describes briefly 20 of the Smyrna fig and caprifig varieties. These descriptions, as well as those by George C. Roeding, have been drawn upon to a considerable extent, while those of seedling varieties which have originated in California are from the studies of the writer at the Loomis orchard and other localities where these varieties are in cultivation. The attempt is made in the descriptions, when practicable, to give sufficient details to enable the reader to identify the variety.

SMYRNA VARIETIES.

Lob Ingir.—The Lob Ingir (fig. 1) known also as Erbeyli, Calimyrna, etc., is the great commercial fig of the Meander Valley, Asia Minor, commonly called Smyrna, after the port from which it is exported to all parts of the world. The tree is a vigorous grower; leaves very large, up to 8 by 10 inches, with generally five lobes, a few with three, and occasionally entire; lobes separated by broad, deep sinuses, obtuse toward apex, finely to coarsely serrate, dark glossy green and rough above, lighter and smooth beneath; petioles and veins greenish white; the former about half the length of the blade; stipules pointed, brown when falling; fruit medium to very large, flat or onion shaped, up to 3 inches in diameter, flat at apex; skin very thin, color light pea green when immature, delicately pubescent, fading to delicate light lemon yellow at maturity, with scattered whitish dots, some of which are elongated; thin, medium to short neck; stem very short; eye large, open, bordered by whitish protruding scales a little lighter than the skin, surrounded by a dark ring or iris, ribs conspicuous from apex to stem, branched, smoothing out as the fruit ripens; seeds large but not very abundant; pulp pink when unripe, deepening to dark amber at maturity; flesh thin, white or greenish white. The sweetest and most luscious fig for consumption fresh and unequaled as a dried fruit. Introduced into this country from Asia Minor by the writer, a small shipment arriving in 1880 and 14,000 cuttings during the winter of 1881–82.

Kassaba.—Introduced from Asia Minor in 1882; tree vigorous, an upright grower, outer branches drooping under a heavy load of fruit; leaves very large, up to 8 by 10 inches, nearly all three lobed; lobes broad toward apex, blunt, making a right angle; sinuses shallow, one-fourth depth of blade, lobes occasionally overlapping; upper surface light glossy green, slightly rough to the touch, smooth and lighter beneath; edges fine to coarsely serrate; petioles and veins greenish white, tomentose, the former one-fourth to one-third the length of the blade; stipules pointed, light green; fruit pyriform, lopsided, truncate; color pea green, fading to lemon yellow at maturity, lighter toward apex; ribs prominent, branched, wider apart toward neck, extending almost from apex to stem; skin with delicate whitish bloom and faint whitish dots; neck short, stout, stem very short; eye medium, open, bracts pinkish and not protruding; pulp pinkish red, darkening to brown at maturity, flesh rather thick before maturity, tinged with green which penetrates a sixteenth of an inch from the skin; seeds medium to large, but not numerous.

Blowers.—Tree thrifty and vigorous, of upright growth; leaves very large, mostly three lobed, a few with five lobes, dark glossy green, rough above, lighter below, veins and petioles yellowish green, edges of lobes dentate; petioles about one-third the length of blade; fruit medium, globose, flattened at apex; ribs irregular, prominent, and darker than skin between; skin lemon yellow, covered with scattered whitish dots; neck small, bent to one side, longer than in the Lob Ingir; stem medium length; pulp

pink before and dark amber after maturity, intensely sweet, good flavor; eye medium, open.

This variety was derived from cuttings of the writer's importation from Smyrna in 1882, planted on the ranch of the late R. B. Blowers, Woodland, Cal. Turkish name unknown; named "Blowers" by Dr. Gustav Eisen.

Eisen.—A seedling of the Maslin orchard at Loomis, Cal., from the best type of imported Smyrna figs. The tree is unfortunately located near a swampy spot in the orchard and is not in normal condition. Grafts have been inserted in better localities where the fruit is showing high quality.

The following description is from vigorous, thrifty grafts. Leaves medium to large, mostly five lobed; lobes bluntly pointed, edges coarsely serrate; upper surface dark, glossy green, rough, smooth beneath, sinuses variable from shallow to deep, with no overlapping of lobes; petioles greenish white, one-third the length of blade, veins a shade lighter, covered with soft tomentum; stipules light green; fruit large to very large, 2 to 2¾ inches in diameter, onion shaped like the Lob Ingir; neck thin, short; stem very short; ribs prominent from apex to neck, often branched; skin very thin and delicate, covered with white dots which remain till maturity; color greenish yellow, changing to translucent amber when dry; occasionally the delicate skin cracks, showing the white flesh within; pulp juicy, light amber, more transparent than the Lob Ingir and extending to very near the skin, leaving the flesh very thin; flavor sweet and rich. A large portion of the crop at Loomis is self-sealed like the Rixford. Cuttings in small numbers have been distributed to the best fig localities, and if its high quality at Loomis is sustained at other places it will prove to be a valuable addition to the list of desirable figs. Named in honor of Dr. Gustav Eisen.

Hilgard.—Large, thrifty tree, spreading top, trunk knobby, 2½ feet in diameter. At 3 feet from the ground it divides into four large branches. Leaves three to five lobed, many entire, glossy green above, rough, light green below; sinuses shallow, lobes acute, edges finely to coarsely serrate; petioles one-fourth to one-third the length of the blade, covered with very short tomentum or glabrous; veins a lighter shade; fruit medium in size, lemon yellow, skin covered with minute whitish dots and very delicate bloom, flat or onion shaped; ribs irregular, branched, extending from apex to stem, smoothing out at maturity; eye open, bracts pink, with a dark circle surrounding; neck very short or none; stem very short; pulp rosy red, deepening to dark amber at maturity; seeds medium sized, not very numerous. This seedling tree of the Maslin orchard at Loomis is almost immune from splitting, while fruit on adjoining trees splits badly. This is a very sweet and excellent flavored fig. Named in honor of the late Prof. E. W. Hilgard.

Rixford.—A seedling raised from the best imported Smyrna brand, planted by E. W. Maslin in 1886 on his ranch at Loomis, Cal. The tree is vigorous, thrifty, and the largest in the Maslin orchard of 172 trees; drooping habit with a spread of branches over 50 feet and diameter of trunk 2 feet; leaves large, up to 8 by 8 inches, light green above without gloss, three to five lobed, a few entire, finely to coarsely serrate, sinuses shallow, not more than one-third the length of blade; petioles one-third to one-half the length of blade, and with veins whitish green, smooth, covered with short, soft tomentum; stipules pointed, whitish green. Fruit medium sized, up to 1½ to 2½ inches, round-obtuse, somewhat flattened at the apex, neck small, short, bent to one side; stem very short; ribs prominent from apex to neck, smoothing out at maturity; skin thin, color lemon yellow, greenish toward the apex, with scattered white dots from center to neck, some elongated; eye small; bracts short, white, surrounded by dark ring at maturity; pulp deep red, changing to brown amber when mature and dry. In a large portion of the figs the eye is sealed as they ripen by the gradual hardening of a drop of pellucid gum, effectually excluding filth and beetles and other insects. They do not sour, as germs of fermentation are also excluded. Very sweet and fine flavor, but with the fault at Loomis in some seasons of splitting badly. One of the earliest

varieties in the Maslin orchard, frequently maturing as early as the first week in August. Described and named by Walter T. Swingle, of the United States Department of Agriculture.

Stanford.—A large, thrifty tree with dense top (fig. 12). Leaves medium to large, three to five lobed or entire, sinuses shallow and broad, lobes bluntly pointed, edges finely to coarsely serrate or wavy; dark green, rough, without gloss on upper surface, smooth beneath, with soft tomentum, petioles one-half to one-third the length of blade and with veins greenish white and tomentose; fruit medium, a little smaller than the ordinary Lob Ingir, turbinate or globular; neck small, very short; stem medium to short; ribs not very prominent, irregular, extending from eye to neck, color lemon yellow, with greenish tinge at maturity; eye very small, surrounded by dark ring, scales whitish; pulp bright rosy red, dark amber at maturity; flesh white, tinged with green.

This variety consists of four giant trees growing on rich bottom land of the Stanford University ranch at Vina, Cal., in a row with ordinary Lob Ingir trees. These trees were grown from cuttings imported from Asia Minor by the writer in 1882. The fruit ripens a week or ten days earlier than that of other Lob Ingir trees and seems to be immune from splitting. During the four years that the variety has been under observation not a single split fig has been found on either tree, although the usual percentage of split fruit was found on the ordinary Lob Ingir trees in the same row. The manager of the ranch permitted the United States Department of Agriculture to take 500 cuttings each year for four years for free distribution. The value of the variety will soon be demonstrated from these widely distributed cuttings. The writer proposes to name the variety "Stanford," in honor of the late Gov. Leland Stanford, founder of Leland Stanford Junior University.

West.—Another of the seedling trees of the Maslin orchard, raised from the best imported Smyrna figs, has been named in honor of the late W. B. West, of Stockton, Cal., who imported a great many varieties of figs from southern Europe and did much for the fig industry in California. It is a large, thrifty, open-top tree, with long-jointed wood and drooping branches, and with a clean, smooth trunk 16 inches in diameter a foot from the ground. Leaves very large, deeply three to five lobed, with coarsely serrated edges, glossy green above, under surface smooth, covered with soft, short tomentum; petioles one-third to one-half the length of blade; fruit medium to large, pyriform; color greenish yellow, retaining the green tint toward the neck up to full maturity; pulp pinkish just before maturity, changing to dark amber when fully ripe. One of the sweetest and best all-round figs in the Maslin orchard. Skin very thin and almost immune from splitting. It bears a fair first crop. It is now being tested in many localities from extensive distributions made by the United States Department of Agriculture.

Wilson.—A clean, thrifty tree of spreading habit. Leaves large, shining, dark green above, lighter and tomentose beneath, mostly three lobed, a few entire; lobes obtuse, sinuses broad, shallow; lobes coarsely to finely serrate, or with wavy edges; petioles large, greenish white, half as long as the blade, slightly tomentose or glabrous; veins same color as petioles; stipules light green, tipped with brown; fruit medium to large, ribs conspicuous; skin thin, delicate, light green, inclined to crack in ripening, covered with scattered whitish dots, pruinose toward the stem; neck very short and thick; stem medium to short; eye medium, open; scales reddish brown, disclosing rosy red pulp within, which darkens to chocolate brown when dry; seeds small, amber color; flesh thin, white. It makes a very good dried fig, rich, but not equal in quality to the Lob Ingir. The variety was imported by the United States Department of Agriculture in 1891 and named by Dr. Gustav Eisen in honor of James Wilson, at that time Secretary of Agriculture.

Bardakjik.—Tree a compact, low-spreading grower, with thick, closely jointed branches, leaves very large, five lobed, sinuses shallow. Fruit handsome, medium to

large, pyriform, with short neck and long stem. Color light grayish green, covered with small gray dots, especially toward the neck, ribs distinct; eye small, scales not protruding, apex flat; skin very thin and delicate, cracking at full maturity, showing the white flesh beneath; pulp a rich brilliant red, seeds small and numerous. A first-class table fig, grown exclusively for that purpose in the Smyrna district of Asia Minor. Roeding says that scattering trees are to be found in gardens near Smyrna and in the foothills a few miles from the city. They are always caprified, but not so systematically as in the fig district proper.

CAPRI VARIETIES.

Milco.—Tree vigorous, symmetrical, spreading, dense top, clean, smooth trunk and branches (fig. 5); leaves medium to large, three to five lobed, dark glossy green above, lighter below, lobes bluntly pointed, finely to coarsely dentate, sinuses shallow; petioles half the length of the blade and with the veins hairy; stipules pointed, green, turning brown when falling; profichi fruit medium to large, turbinate, lopsided; neck short and stout; stem short, but increasing in length on those figs growing toward the end of the old wood; ribs prominent when young, smoothing out as the size increases; quite firm when the insects are ready to issue; color dark green, lighter toward the stem, assuming a reddish brown at maturity; eye small, with pinkish scales. This caprifig is unique in having a few male flowers scattered among the gall flowers; cluster of stamens not large; gall zone well developed and generally filling the cavity of the receptacle; flesh greenish white, with band of dark violet stain. The profichi crop, with its generation of Blastophaga, matures later than most varieties. There is little doubt that the variety was imported from Italy by the late W. B. West, of Stockton, under the name Verdoni, but was exploited by G. N. Milco, whose name became attached to it.

The Milco is an early bearer and one of the most valuable figs in cultivation. It carried its annual crop of fruit and fig wasps for 40 years on the old Gates tree, 10 miles west of Modesto, Cal., and on others in the vicinity of Lathrop, Cal., unaided by other trees in the neighborhood.

Loomis.—A very thrifty, open-topped tree; leaves three to five lobed, a few entire; lobes broad toward the apex and obtuse, sinuses shallow, edges finely to coarsely serlate; petioles half the length of the blade and with veins greenish white, slightly tomentose; upper surface glossy green and very rough, under surface lighter and smooth. Foliage holds later than most trees. Stipules purplish brown when falling. Mamme crop good, up to half an inch to 1½ inches in diameter. The figs of the profichi crop are very large, up to 2½ inches in diameter, and have a distinct neck and prominent ribs. This tree never fails to carry a good mamme crop, and it produces one of the earliest profichi crops in the orchard.

Newcastle.—Knobby trunk with spreading top, thrifty; leaves rough glossy green with three to five lobes, mostly five, sinuses broad, half the depth of tle blade, no overlapping of the lobes, margins coarsely serrate and lobes acute, petioles short, one-half the length of the blade, creamy white; leaves slightly glossy, green and rough above, lighter green beneath; petioles and veins slightly tomentose; carrying a fair mamme crop from three-quarters of an inch to 1¼ inches in diameter. Mammoni crop fair, containing many seeds. Produces an early profichi crop. Tree vigorous and holding foliage late.

Mason.—A thrifty, spreading tree, dense top, clean, smooth trunk; leaves with three to five lobes, smooth surfaces, upper side dark green, under side a little lighter, sinuses deep, one-half to two-thirds the length of the blade, edges finely serrate to wavy, points of the lobes obtuse; petioles one-third to one-half the length of the blade, veins slightly tomentose. A splendid and very early caprifig, never failing to carry a mamme crop through the winter. Profichi figs large, with enormous staminate cluster and a long season.

Ficus pseudocarica.—Introduced into California by Dr. Franceschi, of Santa Barbara. Thrifty tree, spreading habit, young wood pink, covered with short dense tomentum; leaves medium sized, with three and five lobes, sinuses broad and shallow, one-quarter to one-third the depth of blade, lobes acute pointed, glossy green above, lighter below; petioles and veins pinkish, covered with soft tomentum; petioles half the length of the blade; stipules greenish pink. Figs of the mamme crop three-eighths to one-half an inch in diameter, long, slim neck, stemvery long, greenish red; profichi figs small, one-half to five-eighths of an inch in diameter, coppery red, long stem and neck, ribs prominent, color reddish toward sun; eye small, raised above surface, scales red. This caprifig, a native of northeastern Africa, is peculiar in that figs of the mamme crop always contain stamens and can be used to caprify first-crop Smyrnas, a fact noted first by Walter T. Swingle, of the United States Department of Agriculture.

Bleasdale.—Large spreading tree, dense top, clean trunk about 1½ feet in diameter; leaves dark glossy green, rough, mostly three, a few five lobed, many entire, large, up to 8 by 8 inches, lobes obtuse, sinuses broad and shallow, half the depth of the blade, edges finely to coarsely serrate or wavy; carries a good mamme crop from three-fourths of an inch to 1½ inches in diameter; petioles medium to long, up to one-half to two-thirds the length of the blade, petioles and veins greenish white and slightly tomentose. Figs of the profichi crop green and firm when the insects issue; rather late; abundant staminate cluster and large gall zone. One of the most valuable seedling capri trees of the Maslin orchard, never failing to carry a good mamme crop through the winter, with a very large profichi crop in the spring. Named for the late Dr. John Bleasdale, a prolific writer on the fig.

Roeding No. 1.—A thrifty tree of low, spreading habit, long-jointed wood, leaves dark green without gloss, lighter shade below, three and five lobed, some entire, sinuses broad, shallow, edges coarsely serrate or wavy, petioles one-third to one-half the length of the blade and with the veins covered with soft tomentum. Profichi figs pyriform, small, neck long, few and not pronounced ribs, skin dark dull green, with whitish dots, orifice large, flesh stained purple, gall flowers numerous, staminate flowers producing abundance of pollen. Profichi figs a week earlier than Roeding No. 2. The first Blastophaga were established in this country in the profichi crop of this variety from the importations of Mr. Walter T. Swingle in April, 1899. [Chiefly Mr. Roeding's description.]

Roeding No. 2.—Thrifty, erect growth, with slender limbs and long-jointed wood; leaves medium to large, three and five lobes, dark green, smooth, sinuses medium depth, one-half that of the blade, lobes often overlap, edges of lobes wavy; petioles long, one-half to two-thirds the length of blade and the veins greenish white, covered with soft tomentum; lobes bluntly pointed. Profichi fruit medium, almost globular; short stem and neck; ribs distinct, but not prominent; skin smooth, waxy, greenish yellow; apex flat, eye medium, slightly raised; gall flowers numerous. Mamme crop usually wanting or very small; profichi crop abundant. Valuable, Mr. Roeding says, as lengthening the season for caprifying the Smyrna fig, but not reliable by itself, as it does not carry a mamme crop through the winter.

Roeding No. 3.—Tree thrifty, straggling growth, of dwarfish habit; leaves medium, three and five lobes, glossy green, rough above, lighter beneath, lobes broad toward the apex, bluntly pointed, sinuses broad and half the length of the blade, no overlapping of lobes, edges coarsely serrate or wavy; petioles and veins greenish white, covered with short tomentum. Profichi fruit medium sized up to 3 inches long, turbinate, neck and stem short; ribs conspicuous from apex to neck; skin light shining green, thickly covered with whitish dots; eye large, protruding from a sunken apex; good gall zone and staminate cluster; meat thick, stained with purple. The earliest of the Roeding varieties and perhaps the most valuable, as it usually carries the mamme crop through the winter.

OPPORTUNITIES IN THE INDUSTRY.

At the present time the annual production of dried figs in California amounts to about 6,000 tons, one-third of which are of the Smyrna type and the remainder chiefly Adriatic and Mission, the Adriatic including by far the largest quantity. The reason for this is that the Adriatic was extensively planted many years before the Smyrna was introduced. In a few instances Adriatic figs are still being planted under the mistaken idea that they are more prolific bearers than the Smyrna variety. One prominent grower in the San Joaquin Valley who has orchards of both Smyrna and Adriatic finds that by a liberal supply of caprifigs he gets a ton to the acre more from the Smyrna than from the Adriatic variety, while the former sells for about double the price of the latter. At the present time he is engaged in grafting his Adriatic trees to the Smyrna variety. The fig plantings at present are confined almost entirely to the Smyrna type and it is only a question of a few years before the markets of this country will be supplied with home-grown Smyrna figs.

The cutting off of the supplies of figs from Asia Minor and the countries of southern Europe by the war has so raised the prices as greatly to stimulate the planting of figs in this country. It is a reasonable estimate that 10,000 acres of Smyrna fig trees have been planted in the central San Joaquin Valley alone during the last two years. When these large plantings come into bearing, this country will be independent of importations from Smyrna, and dried figs by the carload will be as evident in commercial movements as raisins are at the present time.

To show the increasing demand for the best figs, the purchasing agent for the eating houses and the newsboy trade on one of the large railroad systems of the country in 1913 contracted with a leading packer for 80,000 half-pound cartons of California-grown Smyrna figs, and the supply proved insufficient. In 1914 he contracted for 100,000 packages, and the supply was still insufficient. In 1915 he contracted for 120,000 packages. This buyer never handles any other figs as long as the California-grown Smyrna supply holds out.

A 4-year-old Smyrna fig orchard ought to produce sufficient fruit to pay all the expenses of cultivation, and from that age will yield increasing crops indefinitely. The owner of one 20-acre orchard 9 years of age in 1914 reported a net yield of the value of $115 per acre. The owner of a 40-acre orchard in the same locality, 13 years old, reported an income of $250 per acre. However, it should be mentioned that part of the last-mentioned crop was shipped to city markets undried. Appearances at the present time indicate that it will be but a few years before the 15 or 16 million pounds of figs annually imported from Smyrna will be supplied by the home-grown product.

BIBLIOGRAPHY.

(1) Brandis, Dietrich.
1906. Indian Trees . . . 767 p., 201 fig. London.

(2) Candolle, Alphonse de.
1885. Origin of Cultivated Plants. 468 p. New York.

(3) Chittenden, F. H.
1911. The fig moth. *In* U. S. Dept. Agr., Bur. Ent. Bul. 104, p. 9–40, 4 fig., 4 pl. Bibliographical list, p. 39–40.

(4) Coulter, J. G.
1913. Plant Life and Plant Uses. 464 p., 230 fig., 1 pl. New York, etc.

(5) Cunningham, D. D.
1888. On the phenomena of fertilization in Ficus roxburghii, Wall. *In* Ann. Roy. Bot. Garden Calcutta, v. 1, app., p. 13–47.

(6) Du Breuil, A.
1876. Culture des Arbres et Arbrisseaux à Fruits de Table. 693 p., 555 fig. Paris.

(7) Earle, F. S.
1897. Fig culture in the Gulf States. *In* U. S. Dept. Agr., Div. Pomol. Bul. 5, p. 23–32.

Eisen, Gustav.
(8) 1886. The fig. *In* Off. Rpt. 5th Fruit-Growers' Conv. Cal., 1885, p. 42–50.
(9) 1896. Biological studies on figs, caprifigs, and caprification. *In* Proc. Cal. Acad. Sci., v. 5, p. 897–1001.
(10) 1897. Edible figs: their culture and curing. *In* U. S. Dept. Agr., Div. Pomol. Bul. 5, p. 5–22.
(11) 1901. The fig: Its history, culture, and curing, with a descriptive catalogue of the known varieties of figs. *In* U. S. Dept. Agr., Div. Pomol. Bul. 9, 317 p., 93 fig. Bibliography, p. 295–301.

(12) Fig Institute.
1917. Proceedings . . . Fresno, California, January 12–13, 1917. 111 p. Fresno, Cal.

(13) Figuier, Louis.
1869. The Vegetable World . . . 556 p., 448 fig., 23 pl. London, New York.

Firminger, W. K.
(14) 1904. Manual of Gardening for India, ed. 5, 710 p., illus., pl. Calcutta.
(15) 1890. Fruit culture in foreign countries. *In* U. S. Special Consular Rpt., v. 1, p. 391–937.

(16) Gallesio, Giorgio.
1817–39. Pomona Italiana . . . 2 v., pl. (partly col.). Pisa.

(17) Gasparrini, Guglielmo.
1845. Ricerche sulla Natura del Caprifico, e del Fico; e sulla Caprificazione. 96 p., 8 pl. Napoli.

(18) Gomez, E. R.
1903. Manual sobre Arboles Frutales . . . 480 p., illus. Paris.

(19) GUBB, A. S.
1913. La Flore Algerienne Naturelle et Acquise. 275 p., illus. Alger.

(20) HASSELQUIST, FREDRIK.
1762. Reise nach Palastina in den Jahren von 1749 bis 1752. 606 p. Rostock.

HOGG, ROBERT.
(21) 1858. The Vegetable Kingdom and its Products. 882 p., illus. London.
(22) 1866. The Fruit Manual. ed. 3, 291 p. London.

(23) HOWARD, L. O.
1901. Smyrna fig culture in the United States. *In* U. S. Dept. Agr. Yearbook, 1900, p. 79–106, 7 fig., 8 pl.

(24) HUBERT, PAUL.
1912. Fruits des Pays Chauds. v. 1. Paris.

(25) KING, GEORGE.
1888. The species of Ficus of the Indo-Malayan and Chinese countries. *In* Ann. Roy. Bot. Garden Calcutta, v. 1, p. 1–185, 225 pl.

(26) LANGWORTHY, C. F.
1913. Raisins, figs, and other dried fruits and their use. *In* U. S. Dept. Agr. Yearbook, 1912, p. 505–522.

(27) LAWRENCE, W. H.
1916. Practical fig culture in Arizona. Ariz. Agr. Exp. Sta. Bul. 77, 43 p., 14 fig.

(28) LINNÉ, CARL VON.
1840. Systema, Genera, Species Plantarum. 1102 p. Lipsiae.

(29) LOEB, JACQUES.
1917. The chemical basis of regeneration and geotropism. *In* Science, n. s., v. 46, no. 1179, p. 115–118.

(30) MACMILLAN, H. F.
1910. A Handbook of Tropical Gardening and Planting, with Special Reference to Ceylon. 524 p., illus. Colombo.

(31) MAIDEN, J. H.
1889. The Useful Native Plants of Australia (Including Tasmania). 696 p. Sydney.

(32) MAYER, PAUL.
1882. Zur Naturgeschichte der Feigeninsekten. *In* Mitt. Zool. Sta. Neapel, Bd. 3, Heft 4, p. 551–590, 2 fig., pl. 24–26.

(33) MELLO LEOTTO F. C. DE.
1900. Arboricultura Algarvia ... 221 p. Lisboa.

(34) MIRANDA, VICTOR.
1901. Arboles Frutales. 232 p. Barcelona.

(35) MUELLER, FERDINAND VON.
1881. Select Extra-tropical Plants Readily Eligible for Industrial Culture of Naturalization . . . New South Wales ed. 403 p. Sydney.

(36) OLIVIER, G. A.
1807. Voyage dans l'Empire Othoman, l'Egypte et al Perse. 3 v. and atlas. Paris.

(37) POTTS, A. T.
1917. The fig in Texas. Texas Agr. Exp. Sta. Bul. 208, 41 p., 13 fig.

(38) RAVASINI, R.
1911. Die Feigenbäume Italiens und ihre Beziehungen zu Einander. 180 p., illus., 1 pl. Bern.

(39) Reimer, F. C.
1910. Fig culture in North Carolina. N. C. Agr. Exp. Sta. Bul. 208, p. 187–207, 13 fig.

(40) Rivière, Charles, and Lecq, H.
1906. Cultures du Midi de l'Algérie et de la Tunisie. 511 p., 69 fig. Paris.

(41) Rixford, G. P.
1912. Fructification of the fig by Blastophaga. *In* Jour. Econ. Ent., v. 5, no. 4, p. 349–355.

(42) Roeding, G. C.
1903. The Smyrna Fig at Home and Abroad. 87 p., illus., 1 pl. (col.) Fresno, Cal.

(43) Sargent, F. L.
1913. Plants and their Uses. 610 p., 384 fig. New York.

(44) Sauvaigo, Émile.
1894. Les Cultures sur le Littoral de la Méditerranée. 324 p., illus., pl. Paris.

(45) Schwarz, E. A.
1901. A season's experience with figs and fig insects in California. *In* Proc. Ent. Soc. Washington, v. 4, no. 4, p. 502–507.

(46) Smyth, E. G.
1911. Report on the fig moth in Smyrna. *In* U. S. Dept. Agr., Bur. Ent. Bul. 104, p. 41–65, pl. 5–16.

(47) Solms-Laubach, Hermann.
1882. Die Herkunft, Domestication und Verbreitung des gewöhnlichen Feigenbaums (Ficus carica L.). 106 p. Gottingen.

(48) Starnes, H. N.
1903. The fig in Georgia. Ga. Agr. Exp. Sta. Bul. 61, 74 p., 3 fig., 15 pl.

(49) ——— and Monroe, J. F.
1907. The fig in Georgia (second report). Ga. Agr. Exp. Sta. Bul. 77, p. 41–101, illus., 5 pl.

Swingle, W. T.
(50) 1899. The dicœcism of the fig in its bearing upon caprification. *In* Science, n. s., v. 10, no. 251, p. 570–574.

(51) 1908. Some points in the history of caprification in the life history of the fig. *In* Off. Rpt. 34th Fruit-Growers' Conv. Cal., 1908, p. 178–187.

(52) 1909. The Maslin seedling fig orchard at Loomis, California, and its bearing on the Smyrna fig industry of this country. *In* Off. Rpt. 35th Fruit-Growers' Conv. Cal., 1908, p. 92–100.

(53) 1909. The Rixford: A new type of Smyrna fig. *In* Pacific Rural Press, v. 77, no. 9, p. 161–170.

(54) ——— and Rixford, G. P.
1911. The first establishment of Blastophaga in California. *In* Proc. 38th Fruit-Growers' Conv. Cal., 1910, p. 174–179.

(55) Theophrastus.
1644. De Historia Plantarum . . . 1187 p., illus. Amstelodami.

(56) Wickson, E. J.
1910. The California Fruits and How to Grow Them. ed. 5, 604 p., illus. San Francisco.

(57) Woodrow, G. M.
1910. Gardening in the Tropics. ed. 6, of his Gardening in India. 634 p., illus., pl. Paisley.

ADDITIONAL COPIES

OF THIS PUBLICATION MAY BE PROCURED FROM
THE SUPERINTENDENT OF DOCUMENTS
GOVERNMENT PRINTING OFFICE
WASHINGTON, D. C.
AT

10 CENTS PER COPY